ARMY ORDNANCE

VOL. XVI, No. 92 SEPTEMBER-OCTOBER, 1935

Ordnance Automotive Testing

Lieut. Col. G. M. Barnes

Defense of the Suez Canal

Col. Fred. H. Wagner

Weather and Warfare

Clarence F. Wells

Architectural Air Protection

Dr. Hans Schoszberger

Facts, Pacifism and Ink

Lieut. Col. C. L. Hall

New Weapons in Old Africa

An Editorial

A BIMONTHLY REVIEW OF AMERICAN MUNITIONS
PUBLISHED BY THE ARMY ORDNANCE ASSOCIATION, WASHINGTON, D. C.

RELOADER NEWS

Published by the *HERCULES POWDER COMPANY* Wilmington, Delaware
INCORPORATED

GOOD NEWS FOR PISTOL SHOOTERS

A new booklet, giving complete ballistic data on hundreds of pistol and revolver loads with Hercules "Bullseye" and "Unique" powders has just been made available by the Sporting Powder Division of Hercules Powder Company.

Three charges of each powder together with accompanying ballistic data are shown for each bullet. The result is a direct comparison of the two popular powders, which gives the reloader an unusual opportunity to select loads best suited for his requirements.

Hercules "Bullseye" is perhaps the best-known smokeless powder available to the reloader. It has been on the market since 1900 and has won wide recognition because of its uniform ballistics and economy.

While "Unique" has been manufactured for 35 years, it has only recently come into popular use for revolvers because of its suitability for extra heavy or high velocity loads. An example of Unique ballistics is that in the 44/40 W.C.F. a 140-gr. hollow-point bullet with a charge of 14.1 gr. of Unique has a velocity of 1400 f.s. with normal pressure.

Many other interesting loads are tabulated in the booklet. Besides, there is much helpful information on characteristics and use of each powder.

Copies will be furnished free on request.

SPECIAL HIGH VELOCITY LOADS FOR "VARMINTS"

SHOOTER HAS CHOICE OF MANY LOADS WITH HERCULES HiVEL No. 2, HiVEL No. 3, AND "2400"

High velocity loads, with just the punch to get "varmints," have been worked out for the reloader in some of the new Hercules smokeless rifle powder booklets tabulating hand loads for various powders.

All the loads cited give amazingly high velocity and flat trajectory without developing excess pressures.

Keep some of these loads for reference, or better, send for the booklets and select the loads best suited for your rifle.

2400 LOADS

The 22 Hornet, with a 45-grain hollow-point bullet, develops a velocity of 2605 f.s. with a charge of 10.3 grains. The 25/20 Repeater gives a velocity of 2075 f.s. with 10.5 grains to a 60-grain hollow-point bullet.

HiVEL NO. 3 LOADS

HiVel No. 3, new Hercules powder, developed especially for popular sporting loads, offers some excellent loads for "varmint" shooting.

For example, the 22 Savage Hi-Power has two interesting loads—the 45-grain Hornet hollow-point bullet with a charge of 26.5 grains develops 3710 f.s., while the 70-grain soft-point bullet has a muzzle velocity of 3050 f.s. with a 22.6 grain charge.

The 25 Remington offers 3390 f.s. in the 60-grain 25/20 hollow-point bullet with 28.5 grains of HiVel No. 3. Another "varmint" load will be found for the 250/3000 Savage in which 28.8 grains drive the 60-grain 25/20 hollow-point bullet 3410 f.s.

An important load of HiVel No. 3 is a charge of 33.2 grains in the 110-grain hollow-point bullet for the 30 W.C.F., 30 Remington, and 30/30. This develops a muzzle velocity of 2920 f.s.

The 30-'06 Springfield, another popular gun, takes a 50-grain charge for the 80-grain 32/20 hollow-point and develops 3680 f.s.; the 30/40 Krag with 80-grain 32/20 high-speed bullet gives 3470 f.s. with a 38.3 grain load. The same bullet for the 300 Savage develops 3650 f.s. with 41.3 grains of HiVel No. 3.

HiVEL NO. 2 LOADS

Several HiVel No. 2 loads can be used for "varmint" shooting with good results. In the 270 W.C.F., the 95-grain hollow-point develops 3340 f.s. with a charge of 48.8 grains. The 30-'06 Springfield takes a load of 55 grains to produce a muzzle velocity of 3360 f.s. in the 110-grain high-speed bullet. The 30/40 Krag, using the 110-grain hollow-point bullet with a charge of 41.1 grains of HiVel No. 3 develops 3040 f. s.

Shooters Are Enthusiastic Over HiVel No. 3 Powder

HiVel No. 3, newly announced Hercules sporting powder, has won immediate acceptance by reloaders, fully justifying the claims made for it by Hercules Powder Company.

This new powder apparently is "just right" for the 30/30, 25 Remington, 25/35 Winchester, 250/3000 Savage, and other popular sporting cartridges of medium capacity.

Some examples of its use for popular sporting loads will be found elsewhere in this advertisement in the comment on "varmint" shooting. Only a few of the many loads tabulated in the special booklet are listed.

HiVel No. 3 is more than a powder for popular sporting loads. It also gives excellent results with light bullets in the larger cases, such as the 30-'06.

This powder is meeting with such enthusiastic acceptance because of its accuracy and superior ballistics that Hercules officials are confident it will become one of the largest selling powders for sporting use.

HERCULES POWDERS AT CAMP PERRY

A complete line of powders for all needs of the reloader will be on sale on "commercial row" at Camp Perry during the National Rifle Matches, September 1-19.

Powders carried in stock will include HiVel No. 2, HiVel No. 3, 2400, Lightning, Sharpshooter, Unique, and Bullseye.

Representatives of the company will attend the matches and will be pleased to discuss shooting problems with reloaders.

FOURTH EDITION OF 2400 BALLISTICS SOON READY

The popularity of Hercules 2400 Powder is apparent in the demand for the booklet tabulating the ballistics of the powder. Although Hercules 2400 has been on the market but a few years, it has already become established with reloaders because of its ease of ignition, uniformity of burning, low hygroscopicity, and outstanding accuracy.

In the fourth edition of the booklet, loads have been revised on the basis of new ballistic tests made in the company's ballistic house at Kenvil, New Jersey.

Copies of the 2400 booklet will be furnished to reloaders on request.

Maximum loads are not always the most accurate. In many instances a lower charge will show better accuracy. Try several different charges of powder to fit the load to your own rifle and to get the best accuracy. This sets up an interesting field for experimentation.

HERCULES POWDER COMPANY
INCORPORATED
912 King Street Wilmington, Delaware

K-69

ARMY ORDNANCE

The Journal of the Army Ordnance Association

Now in its Sixteenth Year of Publication

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guaranty of Peace

Published by the Army Ordnance Association, Suite 807, The Mills Building, Washington, D. C. Managing Editor: L. A. Codd. Authors alone are responsible for statements made and opinions expressed in their respective articles. Copyright, 1935, by the Army Ordnance Association, Washington, D. C.

Issued Bimonthly. Single Copy 75c (by mail). Subscription rate: Continental U. S. $4.50 annually, foreign $5.00, in advance. Entered as second-class matter August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional second class entry at the Post Office at Richmond, Va

Volume XVI **SEPTEMBER-OCTOBER, 1935** **No. 92**

CONTENTS

PAGE

ARMY ORDNANCE MEDALISTS, 1935 - Frontispiece
Newton D. Baker, Bernard M. Baruch, Col. Rogers Birnie.

ORDNANCE AUTOMOTIVE TESTING - - - - - - - - - - - - - By Lieut. Col. G. M. Barnes 71

PROVING GROUND (Poem) - - - - - - - - - - - - - - - - - - By Charles E. Ellis 71

DEFENSE OF THE SUEZ CANAL - - - - - - - - - - - - - - - - By Fred H. Wagner 85

ARCHITECTURAL AIR PROTECTION - - - - - - - - - - - - - - By Hans Schoszberger 95

WEATHER AND WARFARE - - - - - - - - - - - - - - - - - - - By Clarence F. Wells 101

FACTS, PACIFISM AND INK - - - - - - - - - - - - - - - - By Lieut. Col. C. L. Hall 106

EDITORIAL - 110

History in the Making—Munitions Control—Generals as Peace Makers—Our Changing National Defense—A Friend of the Services—This Neutrality—New Weapons in Old Africa.

ORDNANCE FIELD SERVICE - 116

Ordnance Activities in the Zone of the Interior, Part II. By Maj. Raymond Marsh.

BOOK REVIEWS - 119

INDEX OF ADVERTISERS - 131

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"Exaggerated confidence in our country's greatness . . . tends to a disregard of the rules of national safety . . . ."—*President Grover Cleveland, Second Inaugural Address, March 4, 1893.*

The Army Ordnance Association

THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our nation's strongest guarantee of peace.

The Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

THE Army Ordnance Association believes that the solution of this problem, based on experience, lies in an active organization at all times coöperating with the Government. The principal objective of the Association is an active membership of American citizens, on whom the duty of design and production of munitions will fall in war, who will have an accurate and authentic knowledge of the complex requirements of ordnance. "Peace insurance" in this form is the foremost aim of the Army Ordnance Association.

The Association is devoted solely to the national defense; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims. Its officers and directors serve without remuneration.

ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the nation's strongest guarantees of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect cooperation with American scientists, inventors, engineers and manufacturers in civil life and the regular and reserve officers of the Ordnance Department;

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

To assist in developing and maintaining an efficient personnel, both commissioned and enlisted, for the units required for Ordnance Field Service in the event of an emergency;

To commemorate the services rendered by the industry of the nation and by the officers and civilian employees of the Ordnance Department in the wars in which the United States has been engaged.

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(The office of 2nd Vice-President is left vacant in memory of the late William C. Spruance whose term would have expired December 31, 1936.)

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THERE are eleven local posts of the Association organized for the more intimate professional contact of members in the achievement of the purposes of the organization. All Association members may affiliate with posts of the locality in which they reside.

New York, Established June 15, 1921

President: Samuel McRoberts. 1st Vice-President: H. B. Machen. 2nd Vice-President: F. W. Roller. 3rd Vice-President: J. E. McNary. 4th Vice-President: William B. Updegraff. Executive Committee: The Officers and Charles Elliot Warren, John Ross Delafield, F. C. Bull, James L. Walsh and L. D. Booth. Treasurer: A. H. Skinner. Secretary: H. K. Rutherford, 39 Whitehall Street, New York City.

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Washington, Established November 18, 1925

President: Earl McFarland. Vice-Presidents: Henry P. Erwin, Chas. E. Munroe. Directors: C. C. Williams, Robert P. Lamont, Swagar Sherley, Howard Bruce, Geo. B. McClellan, Fred E. Wright, Leroy Hodges. Treasurer: C. E. McRae. Secretary: H. A. Strong, Munitions Building, Washington, D. C.

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President: Philip H. Gadsden. Vice-President: George W. Elliott. Directors: John P. Sykes, E. T. Longstreth, J. L. Poultney, C. L. Jordan, John Q. MacDonald, K. K. V. Casey. Secretary-Treasurer: W. C. Hamilton, 808 U. S. Custom House, Philadelphia, Pa.

St. Louis, Established January 18, 1927

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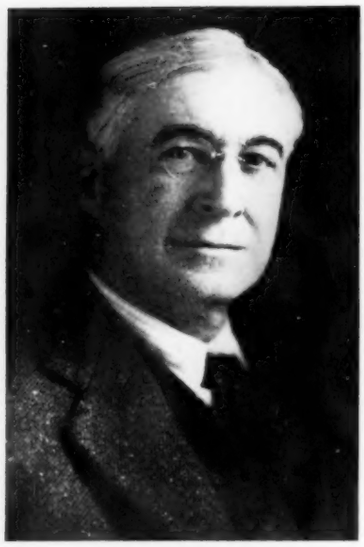
President: W. W. Coleman. Vice-President: Eric H. Lichtenberg. Directors: A. G. Peter, Herbert V. Kohler, Roger Sherman Hoar. Secretary-Treasurer: C. W. Laumann, Bucyrus-Erie Company, So. Milwaukee, Wis.

Birmingham, Ala., Established December 3, 1930

President: Theodore Swann. Vice-President: Lindley C. Morton. Directors: Thomas Martin, Oscar Wells, Hugh Morrow, W. D. Moore, Erskine Ramsay, L. E. Geohegan, Wade H. Oldham, R. C. Stobert. Treasurer: Richard J. Stockham. Secretary: J. D. McIntyre, 250 Federal Building, Birmingham, Ala.

Army Ordnance Medalists, 1935



BERNARD M. BARUCH

"For administrative ability in the cause of national defense exhibited in mobilizing the industrial strength of the United States for the protection of its manpower and the effective prosecution of the World War. The Army Ordnance Association acclaims the former Chairman of the War Industries Board for his skillful and successful leadership in mobilizing the nation's industrial power for the production of armament during the World War, for his broad and practical knowledge of the economic forces contributing to the success of that effort, and for his constant devotion during the years since the war in the interest of planning for the fair mobilization of national resources in times of emergency."

Member advisory commission, Council of National Defense, and chairman of the Council's committee on raw materials, minerals and metals, 1916; Chairman, War Industries Board, March, 1918-January, 1919; member of drafting committee, economic section, American Commission to Negotiate Peace; member, Supreme Economic Council and chairman of its raw materials division; delegate on economic and reparation clauses and economic adviser, American Peace Commission; member, President's Conference for Capital and Labor, 1919; President's Agricultural Conference, 1922; Distinguished Service Medal (U. S.) 1919; Commander, Order of Leopold (Belgium); Commander, Legion of Honor (France); pioneer and author of plans for removal of excessive profit from war. Lecturer, Army War College and Army Industrial College. Chairman, President's Committee for Controlling Excessive War Profit, 1934.

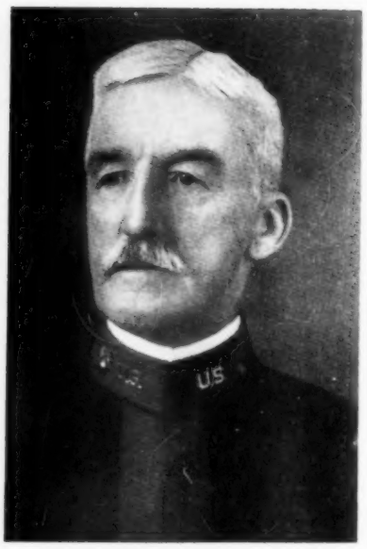
NEWTON D. BAKER

"For distinguished leadership in the successful effort of the military forces of the United States in the World War, and forceful advocacy of adequate national defense. The Army Ordnance Association acclaims the former Secretary of War for his vision, determination and wise administration of the United States Army during the World War, for sponsoring the National Defense Act of 1920 which, for the first time in the history of our nation, provides for the mobilization of material resources and industrial strength as essentials of national defense."

A. B. Johns Hopkins University, 1892; LL. B. Washington and Lee University, 1894; City Solicitor (1902-1912) and Mayor (1912-1916) of Cleveland, Ohio.

Secretary of War March 7, 1916-March 4, 1921; member, Permanent Court of Arbitration, The Hague, 1928; Colonel, Officers' Reserve Corps, U. S. Army, 1921; Distinguished Service Medal (U. S.) 1929; Medalist, National Institute of Social Sciences "for services to humanity."

THE ORDNANCE MEDAL OF MERIT



COL. ROGERS BIRNIE

"For engineering skill and invention in the development of modern armament. The Army Ordnance Association acclaims Colonel Birnie as a leader in the field of modern gun construction and as a technical officer of exceptionally distinguished service to the ordnance cause. In 1887, he presented a thesis before the Military Service Institution on 'Gun Making in the United States,' which marked the beginning of a new era of metallurgical development in gun construction and modernized the entire theory and practice of gun design and manufacture."

Graduate, United States Military Academy (number 1 in class), 1872; engineering service, United States Geological Survey, west of 100 Meridian 1874-79; observer, 9th corps d'Armee, France, 1880. Served with Seventh Army Corps in Havana during Spanish-American War; Inspector of Ordnance, West Point Foundry, Cold Spring, N. Y.; Acting Chief of Ordnance, United States Army, October, 1912-July, 1913; president of Ordnance Board 1913-1915. Retired April 5, 1915.

Pioneer in his advocacy of the built-up forged-steel gun in the United States, Colonel Birnie also used his best effort toward inculcating a philosophy of Ordnance action. In 1887 he wrote: "No one will pretend to say that this gun of today is the culmination of science or that experiments or tests of promising systems should be discontinued . . . The argument is directed chiefly against the delay and procrastination which must be ever present with us if we continue to defer making guns in quantity so long as plausible designs continue to be put forward."

A complete account of the proceedings of the Association's Seventeenth Annual Meeting, October 2 and 3, 1935, (including addresses delivered by the medalists) will be published in the November-December issue of this Journal.

ARMY ORDNANCE

Volume XVI SEPTEMBER-OCTOBER, 1935 No. 92

Ordnance Automotive Testing

Facilities and Methods Used at the Aberdeen Proving Ground

By Lieut. Col. G. M. Barnes*

THE American public in recent years has been made proving-ground conscious largely through the medium of the extensive commercial proving grounds used for the test of automotive vehicles. The Ordnance Department of the U. S. Army has, however, operated its proving ground continuously since 1874. The principal Ordnance Proving Ground was located at Sandy Hook until 1917. After the declaration of war it was found that the shipping entering New York harbor interfered with the firing of the guns to such an extent that it was impossible to test expeditiously the guns, ammunition, and other Ordnance matériel required under the great war program. The Proving Ground at Sandy Hook, therefore, was abandoned and transferred to its present location near Aberdeen, Maryland; the first shot being fired on January 1, 1918. Thereafter it operated at full capacity, employing some 8,000 workers at the peak. After the Armistice, the force was gradually reduced until at the present time it is operated by a skeletonized organization of military and civilian engineers.

PROVING GROUND

No roll of drums, no bugle's blare,
No martial panoply is there
Amid the devastated scene
Wrought by trinitrotoluene.

No strident-voiced commands are heard;
All orders are by written word,
As formulas are carried out
To save some future force from rout.

There Death lurks near as tests are made
By men both skilled and unafraid.
There battles still unfought are won
By test shots from a single gun.

May all the preparations there
For war by land and sea and air
Continue to the maximum—
And may the next war never come!

CHARLES E. ELLIS†

The period between the Armistice and the present has been an active one in the development of ordnance. Naturally the war greatly accelerated the improvement of ordnance and much was learned about the shortcomings of all existing types of weapons. Since the war the Ordnance Department has been perfecting new types of weapons to replace the World War types. It has been the function of the Proving Ground to try out the new weapons and to separate the promising from the impracticable ones, to assist in the development of new types, to overcome defects and to test and retest until each new type of equipment is either discarded as impractical or improved to such an extent as to permit manufacture for issue to the service.

The motorization and mechanization of the Army have been going steadily forward and the solutions of many problems concerning the new types of equipment involved are being found. In 1917 motor transportation was still in its infancy and the extent of the improvement since in all types of motor vehicles is common knowledge. The progress which has been made in commercial automotive equipment has made possible outstanding improvements in all types of fighting automotive vehicles, so that today none of the World War vehicles could be considered suitable as equipment for a modern army. The power which is being placed at the disposal of each soldier in the field, from the automatic shoulder rifle through the new types of high-power artillery to the swift armored tank, is still rapidly being increased.

While the Proving Ground tests all types of ordnance equipment, this article will be confined to a description of the methods and apparatus used in the test of ordnance automotive vehicles such as tanks, combat cars, armored cars, scout cars, gun carriages, trailers, tractors and similar automotive equipment. It is the aim of the Proving Ground to so thoroughly conduct automotive tests that any vehicle, whether of Ordnance design or commercial pattern, receiving the approval of the Proving Ground may be expected to give reliable service when issued to the combat arms of the Army.

The more important types of equipment and test courses used in automotive tests, and the type of engineering information which is obtained from the various classes of tests, are briefly described. In general these tests fall under two principal headings: laboratory tests, by means of which engineering data may be obtained concerning various automotive components, and field tests which are made with the complete vehicle under operating conditions in the field.

THE automotive laboratory (Fig. 1) is equipped with Sprague Electric Dynamometers for use in measuring engine horsepower and torque (Fig. 2). A 3-speed gear box is also available to enable the losses through the transmission to be determined (Fig. 3). Two Sprague Electric Dynamometers, directly connected to reduction gears and mounted on platens (Fig. 4), can also be attached to the final drive of the power train of a tank or other automotive vehicle and the losses and efficiencies of the entire power system measured. These two dynamometers are also used as the basis of the track-testing machine, which is described below. Thus in the case of a combat car or tank, the power developed, the losses and efficiencies can be determined, starting with the engine and its accessories through the cooling fan, the clutch, transmission, final drive to the track drive sprockets or rear axle of the vehicle. This dynamometer equipment requires no special

*Formerly Chief of the Automotive Testing Division, Aberdeen Proving Ground, Maryland.

†Major, Ordnance Reserve, U. S. Army. This poem is republished by permission of the author and of the Editor, *The Sun*, New York, in which it was first published August 21, 1935.

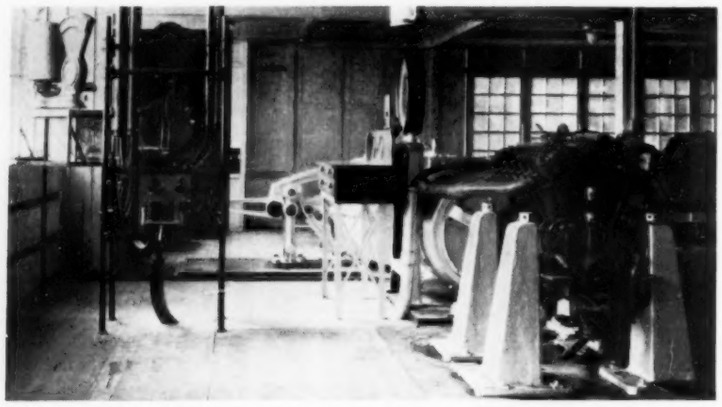


Fig. 1. Aberdeen Automotive Laboratory Engine Test Dynamometer.

description, since it is similar to that usually found in automotive laboratories, and is mentioned here only for the sake of completeness and to point out that the losses occurring throughout all parts of the vehicle can be determined, as will be seen when the equipment used for measuring the performance of the vehicle as a whole is later described.

As most cross-country fighting vehicles are of the tracklaying type the Ordnance Department is primarily concerned with this general class. The most common commercial vehicle in this class is, of course, the tractor. Modern fighting tanks and combat cars are required to move at high speeds cross-country, so that many problems are encountered in the construction of these vehicles which are not found in designing the relatively slow speed commercial tractor. A complete knowledge of the action of tracks, especially at the higher speeds, is therefore essential.

As it is desired to know the power losses occurring in various types of tracks, independently of the vehicles on which they are mounted, throughout all speed ranges, the track testing machine shown in Fig. 4 was designed. Previously the relative efficiencies of different types of tracks was obtained by comparing the resistance to traction of various tracklaying vehicles. The resistance to traction of a tracklaying vehicle includes other losses besides those developed by the track, such as the losses due to contact of the track with the ground, air resistance, especially at the higher speeds, resistance of the bogie or roller system used to support the track and the losses of any gears which revolve, such as the final drive gears, when the vehicle is towed to obtain this resistance to traction.

By mounting the track with its drive sprocket and idler on the track testing machine it is possible to determine the losses in the track independently of all other factors. In this way comparisons can be made between losses occurring in different types of tracks. Fig. 4 shows the set-up for testing a typical track. The drive sprocket is mounted on the shaft of dynamometer and reduction gear in the foreground. The idler is placed on the shaft of the second dynamometer and reduction gear. If the test is made under no load conditions the idler shaft is disconnected from the second dynamometer and reduction gear. If power is to be transmitted, the idler is replaced by a second drive sprocket and both dynamometers used. Speeds are computed as corresponding ground speeds of the vehicle. Fig. 5 shows the type of data which can be obtained with this machine. It will be observed from this diagram that, by lubricating the pins of a track, the power losses can be greatly reduced. This is due to the fact that the power losses result principally from the centrifugal forces developed when the track moves around the sprocket and idler.

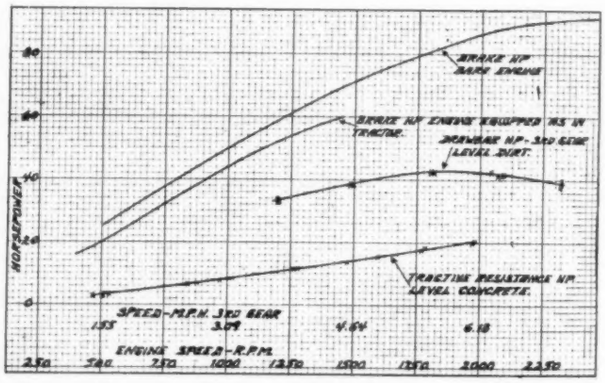

HORSEPOWER
BRAKE HP BARE ENGINE
BRAKE HP ENGINE EQUIPPED AS IN TRACTOR
DRAWBAR HP - 3RD GEAR LEVEL CONCRETE
TRACTIVE RESISTANCE HP LEVEL CONCRETE
SPEED - M.P.H. 3RD GEAR
ENGINE SPEED - R.P.M.

Fig. 2. Chart of Test—35 H. P. Commercial Tractor.

The basic characteristics governing the performance of all tracks have been determined by this class of test. A few of the more interesting facts concerning the performance of tracks follow: (a) The horsepower losses of a track are only slightly increased if the horsepower transmitted is increased and these losses are nearly independent of the horsepower transmitted. (b) The horsepower loss is not appreciably affected by the length of the track. (c) The greater the initial tension in the track the greater the horsepower loss. Therefore a tight track means decreased performance of a tracklaying vehicle. (d) The principal track losses are caused by centrifugal forces, thus the greater the speed of the vehicle the greater the losses. As will be seen by the diagram just referred to, the two tracks of a tracklaying vehicle at 35 miles per hour require 90 horsepower just to drive them at this speed. This is one of the reasons why engines of large horsepower are required to give tanks high speeds; there are others, of course.

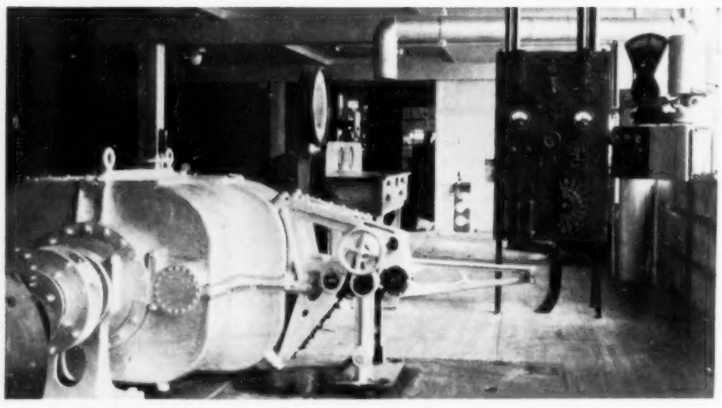


Fig. 3. Front View of Engine Test Dynamometer.

Whenever laboratory tests such as described above are feasible, valuable engineering data can be obtained concerning the efficiency of components entering into the construction of automotive vehicles. These tests precede the field tests by means of which the capabilities of the vehicle to operate as designed, are determined.

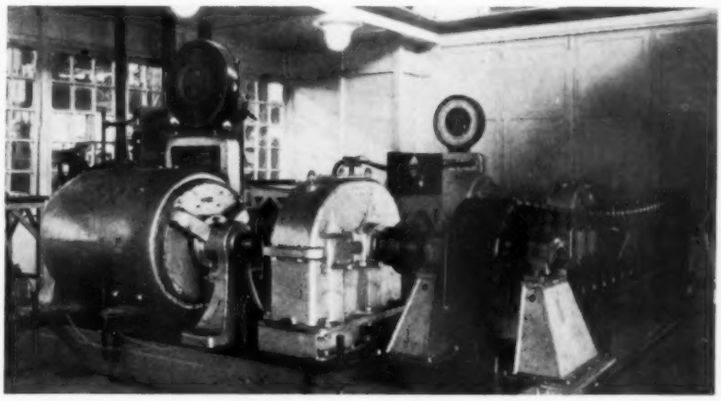


FIG. 4. TRACK-TESTING MACHINE (SHOWING TANK TRACK WITH SUPPORT REMOVED).

ONE of the most universal pieces of equipment for determining the performance of an automotive vehicle at the Proving Ground is the Field Dynamometer M3 (Fig. 6). This apparatus will measure the drawbar pull and drawbar horsepower developed by any vehicle of the wheeled or tracklayer type on different types of courses such as concrete, gravel, sand, mud, etc. The dynamometer can also be used to obtain resistance to traction of any vehicle as a function of speed. It is not the best method of measuring resistance to traction at higher speeds on account of the air turbulence caused by the dynamometer. This subject is discussed later. Several

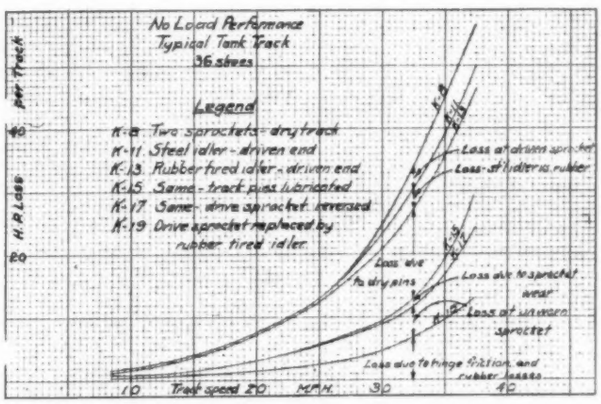

No Load Performance
Typical Tank Track
36 shoes
Legend
K-9 Two sprockets - dry track
K-11 Steel idler - driven end
K-13 Rubber tired idler - driven end
K-15 Same - track pins lubricated
K-17 Same - drive sprocket removed
K-19 Drive sprocket replaced by rubber tired idler
Loss at driven sprocket
Loss - all idler is rubber
Loss due to dry pins
Loss due to sprocket wear
Loss at universal sprocket
Loss due to hinge friction and rubber losses
H.P. Loss per Track
40
20
10
Track speed 20 M.P.H. 30
40

FIG. 5. DATA CHARTED BY TRACK-TESTING MACHINE.

other uses have been found for the dynamometer such as its use in making cooling system tests and in testing the strength of the power train of an automotive vehicle including clutch, transmission, propeller shafts, sprocket shafts and final drives. Prior to the construction of the Dynamometer M3 no entirely satisfactory method was available for obtaining a variable drawbar load. The method previously used was to attach tractors, gun carriages and other vehicles with brakes applied until the desired drawbar pull was obtained (see Fig. 7). The pull was measured by means of a hydraulic cylinder and piston with recording device mounted upon a small 4-wheel carriage which can be seen in the photograph directly behind the truck under test. It will be appreciated that this method was slow and that it was difficult to adjust or change the drawbar load by small increments. The readings obtained were apt to be jumpy and it was, therefore, difficult to obtain satisfactory accuracy throughout the test. The maximum speed obtainable by this method was also limited to about four miles an hour. Modern fighting vehicles are high speed vehicles and data must be obtained at the higher speed ranges. The dynamometer M3 was built to overcome these deficiencies. A 10-ton commercial 6 x 4 truck was used as the basic vehicle. Two fire pumps were mounted upon the truck frame and connected to the main propeller shaft through a commercial transmission and suitable reduction gears. When the dynamometer is pulled, by a vehicle being tested, the rotation of the rear wheels of the dynamometer truck produces a corresponding rotation of the fire pumps which pump water from the tanks, also mounted upon the truck frame, past a suitable adjustable valve back to the same tanks. By adjusting the valve, the discharge pressure of the pumps can be increased or decreased at will, increasing or decreasing the torque required to turn the rear wheels of the dynamometer truck. As the drawbar load, which can be developed by the dynamometer depends upon the traction of the rear wheels, it is necessary to place additional weights in the truck body to obtain the maximum load. Space is provided just in rear of the fire pumps and water tanks for lead weights for this purpose. It has been found that this hydraulic dynamometer system produces smooth pulls which can be varied by small increments. The maximum drawbar pull for which the machine has been used is 18,000 lbs.

The measuring and recording system of this dynamometer may be of interest. It will be seen from Fig. 6 that there is a special drawbar mounted at the front end of the truck, and a similar drawbar is also attached at the rear. These drawbars are adjustable in height and the front one is swiveled to permit turning. Each drawbar consists of a special hydraulic cylinder equipped with piston and piston rod. The drawbar eye is attached to the piston rod, while the

FIG. 6. FIELD DYNAMOMETER (M-3) FOR DETERMINING PERFORMANCE OF AN AUTOMOTIVE VEHICLE.

Fig. 7. Method Previously Used to Determine Variable Drawbar Load.

cylinder is held stationary relative to the truck. Thus when the vehicle under test pulls upon the dynamometer the drawbar cylinder which is filled with oil is put under pressure. This pressure is transmitted through a flexible tube to the recording hydraulic gauge located in the driver's cab. Fig. 8 shows this recording instrument. The pressure is recorded on a moving paper by a Tabor pressure gauge. Concurrently, time in 2/5 second intervals is recorded on the same moving paper. Distance is likewise recorded on the paper by a marker operated electrically by the rotation of the wheel or drive sprocket of the vehicle under test. A push button operates a second marker. The operator presses this button when opposite stakes along the course. Thus time, distance and the total pull developed by the vehicle under test are accurately measured and continuously recorded. The pull which the vehicle is developing is adjusted by regulating the pump valve, as explained above, until the desired engine speed is obtained. The engine speed is indicated by an electric tachometer attached to the engine being tested. The tachometer dial is placed on the dynamometer in view of the operator of the pump, so that its valve can be regulated until the engine maintains the desired speed. From the above recorded data, the drawbar pull and the drawbar horsepower of any vehicle can be computed.

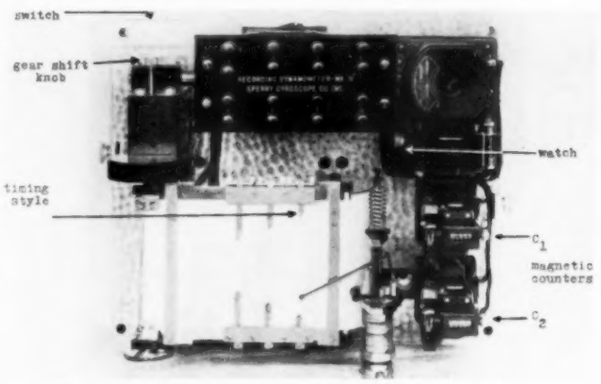


Fig. 8. The Sperry Recording Dynamometer.

The resistance to traction of the vehicle is found by attaching that vehicle to the rear drawbar of the dynamometer (Fig. 9). The rear hydraulic drawbar is also connected with the same recording instrument. In this case the dynamometer engine is used to pull both vehicles, the water pumps being disconnected. The pull of the vehicle being towed is recorded at various speeds. As will be discussed later this method is applicable up to speeds of about 20 miles per hour. At higher speeds, the air turbulence produced by the dynamometer, begins to affect the accuracy of the results due to the increasing effect of air resistance.

The following data sheets show the type of engineering data which can be obtained with the Field Dynamometer M3. Figure 10 gives the drawbar pulls and drawbar horsepower

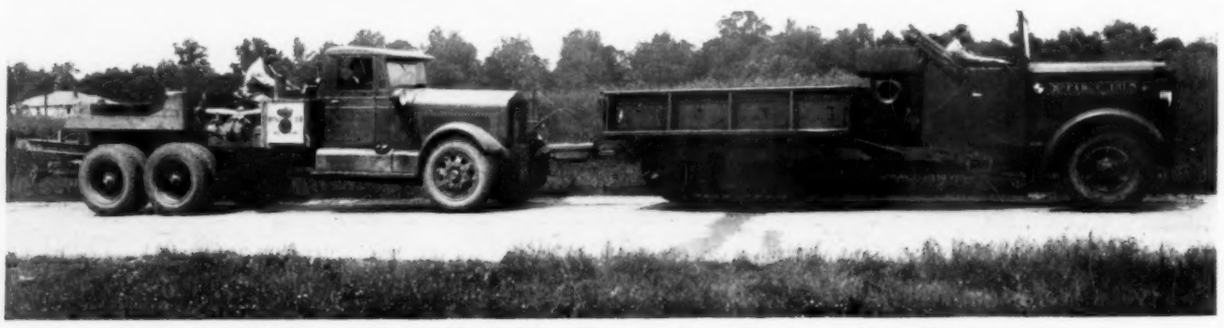


Fig. 9. Half-Track Truck Undergoing Drawbar Pull Test with Field Dynamometer.

developed by a commercial 15-ton tractor at various engine speeds and in different gears. These data were taken on a level dirt course. The tracks were smooth and without grousers.

Fig. 2 shows the drawbar horsepower developed in third gear by a five-ton commercial tractor, plotted as a function of engine speed or speed of vehicle in miles per hour. A comparison of the developed brake horsepower of the engine with the drawbar horsepower of the vehicle is of interest. The lower curve gives tractive resistance of the same tractor measured by the dynamometer. At any speed the sum of the value of horsepower tractive resistance plus the drawbar horsepower should equal the net brake horsepower of the engine except for unmeasured gear losses within the vehicle. We see, for example, from the curves (Fig. 2) that at an engine speed of 1250 r.p.m.: available power of engine equals 54 horsepower; the tractive resistance equals 11 horsepower;

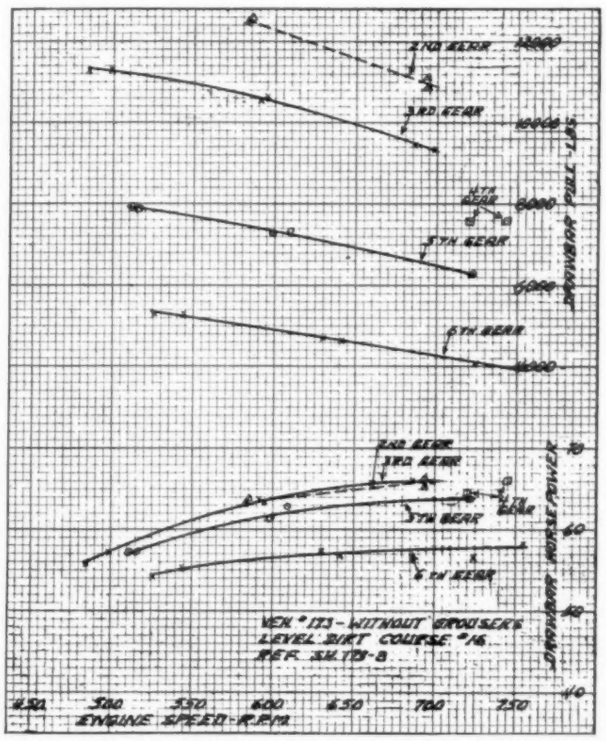


FIG. 10. DATA OBTAINED WITH FIELD DYNAMOMETER.

Drawbar pulls and horsepower developed by a commercial 15-ton tractor at various speeds and in different gears.

the drawbar pull equals 34½ horsepower. In this particular case approximately 64 per cent of the available horsepower of the engine is available for useful work at the drawbar.

Somewhat similar relationships are shown on Fig. 11 for a half-track type of vehicle weighing 9,000 lbs. These data show that second gear gives the best efficiency for this vehicle measured in terms of brake horsepower and available drawbar horsepower. In fifth gear the efficiency is approximately 44 per cent as compared with 67 per cent for second gear operation.

Fig. 12 gives a complete picture of the drawbar pulls and drawbar horsepower characteristics of a 10-ton commercial tractor, on level dirt, straight and curved courses and on a straight level sand course. The engine and ground speeds are given as is also the percentage slip of the tracks. It may be of general interest that dynamometer tests demonstrate that the drawbar pull is increased as the per cent slip is increased up to about 20 per cent slip. No appreciable increase in drawbar pull is developed if the slippage exceeds this amount.

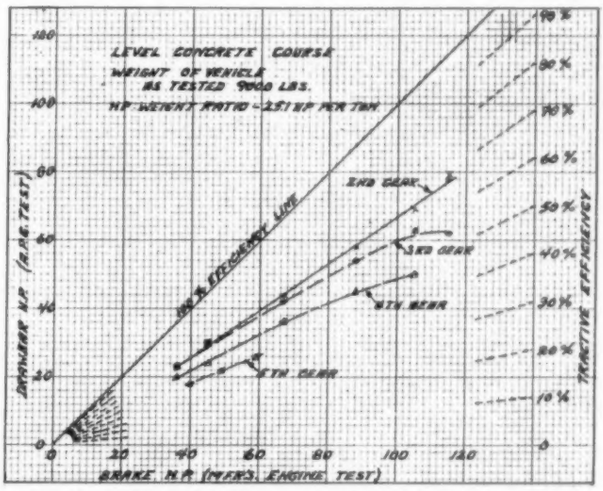


FIG. 11. FIELD DYNAMOMETER DATA FOR 9,000-POUND HALF-TRACK VEHICLE.

A SMALL dynamometer based on a (4 x 2) 1½-ton commercial truck, operating upon the same principles as the large machine, has been constructed. This small dynamometer is used for making the similar tests with lighter vehicles and for tests in sand and mud where the pull developed by most vehicles is greatly reduced. It may also be coupled with the large dynamometer to give increased load capacity. (See Fig. 13.)

A very valuable instrument for measuring the performance of a vehicle is the so-called accelerometer which records continuously on a moving paper the time and distance traveled by the vehicle. This instrument was constructed at the Proving Ground. Times in intervals of 2/5 seconds are

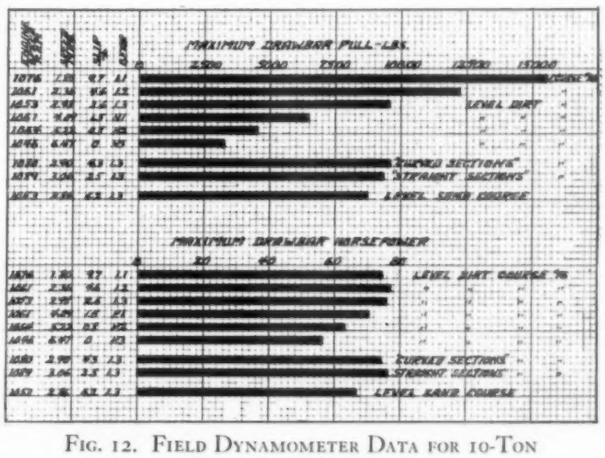


FIG. 12. FIELD DYNAMOMETER DATA FOR 10-TON COMMERCIAL TRACTOR.

Showing characteristics on level dirt, straight and curved courses and on a straight level sand course.

obtained from a clock movement. A special rubber-tired road wheel which can be temporarily attached to the vehicle under test is used to obtain the distance record, each revolu-

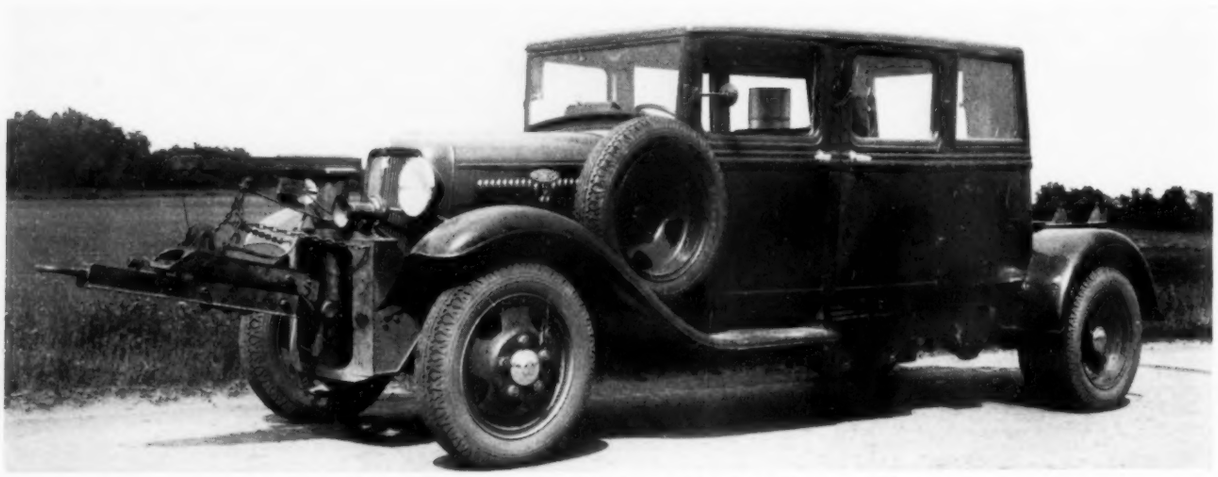


FIG. 13. FIELD DYNAMOMETER (M-4) FOR TESTS OF LIGHTER VEHICLES.

tion of the wheel being recorded on the moving paper. (See Fig. 14.)

Fig. 15 indicates the type of data which can be obtained with this instrument. The curves show the times required for two 4½-ton vehicles with different horsepower weight ratios to reach various speeds from a standing start. An increase of 4.5 horsepower per ton gives the vehicle greatly improved performance. Fig. 16 gives the deceleration of the same vehicle when the brakes are applied. It is seen that this 4½-ton 4 x 4 vehicle, equipped with 4-wheel brakes, will stop from a speed of 30 miles per hour in 100 feet. The instrument therefore, provides an accurate method of measuring braking power. The uses of the accelerometer in measuring resistance to traction of vehicles, especially at high speeds, and its use in obtaining slope performance records of a vehicle, are described later.

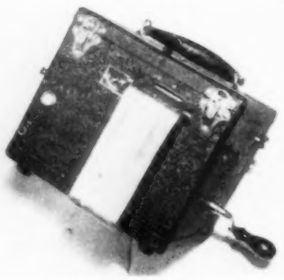


FIG. 14. RECORDING ACCELEROMETER.

Which records continuously on a moving paper the time and distance travelled by a vehicle.

The method of measuring the resistance to traction of a vehicle by using a field dynamometer has been described. It was pointed out that this method becomes less accurate as the speed is increased due to air disturbance caused by the dynamometer, which is placed ahead of the vehicle being tested. Attempts to overcome this objection by other observers using a long cable between the dynamometer and the vehicle under test have not proved successful.

The accelerometer described above and shown in Fig. 14 makes it possible to obtain an accurate determination of the resistance to traction as a function of speed by measuring decelerations under certain conditions.

If a vehicle coast with engine disconnected in still air on a level road surface, the slope of the velocity curve is related to the resistance to traction, thus $R = Ma + Ka$ (1). R is the resistance to traction; M is the mass of the vehicle; K is a constant obtained by considering the rotating parts reduced to a mass revolving at a fixed distance from the center, in which case the angular velocity is proportional to the linear velocity; a is the linear deceleration ft./sec.^{2} for each velocity value considered. In the above equation M is known and a is obtained for any speed from the slope of the velocity curve which in turn is obtained from the time-distance record made by the accelerometer. K and R are therefore the only unknown quantities. R can be obtained by coasting down a hill of known grade having a similar type of road surface.

If the vehicle be allowed to coast down a known grade, and the velocity curve plotted so that the constant speed which the vehicle finally attains is accurately known, then the resistance to traction of the vehicle for that speed is known since it is balanced against the weight component of the vehicle. Thus $R_1 = W \sin b$. Where W is the weight of vehicle

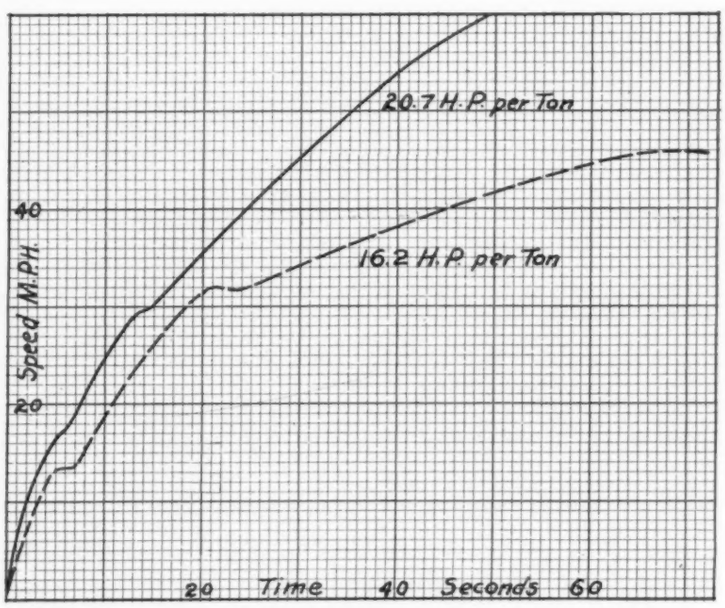


FIG. 15. COMPARATIVE ACCELERATION THROUGH GEARS AS DETERMINED BY ACCELEROMETER.

and b, the angle of slope of the grade. Substituting R1 in equation (1) and using a corresponding to the same velocity as found by coasting down hill, K becomes known and can be substituted in equation (1) and R obtained as a function of V.

Fig. 17 shows a resistance to traction determination made by the dynamometer and one calculated by the deceleration method. There is a close agreement between the two methods, except at the higher speeds.

The sand course (Fig. 18) consists of an open concrete box 500 feet long, 20 feet wide by 18 inches deep filled with washed sand. The top of the box is flush with the ground surface and is level throughout its length. At one end there is a circular concrete box 100 feet in diameter filled with sand to the same depth. The concrete bottoms of both boxes slope slightly and are provided with suitable drains so that the rain falling in the sand will be quickly carried off. Before a test is made the sand is harrowed using a tractor towing a spring-tooth harrow.

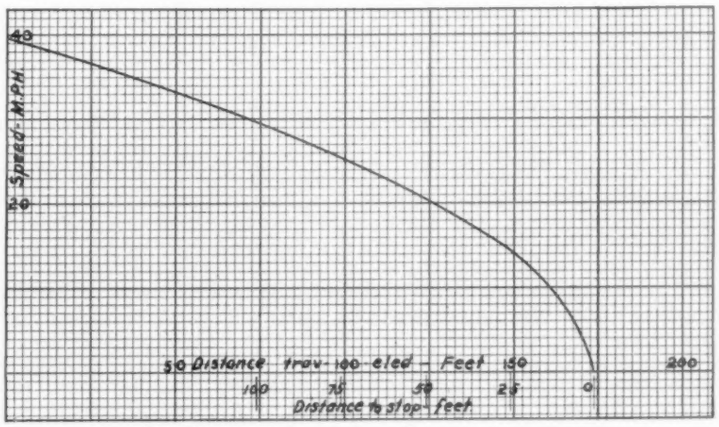


FIG. 16. DECELERATION WHEN BRAKES ARE APPLIED AS SHOWN BY ACCELEROMETER.

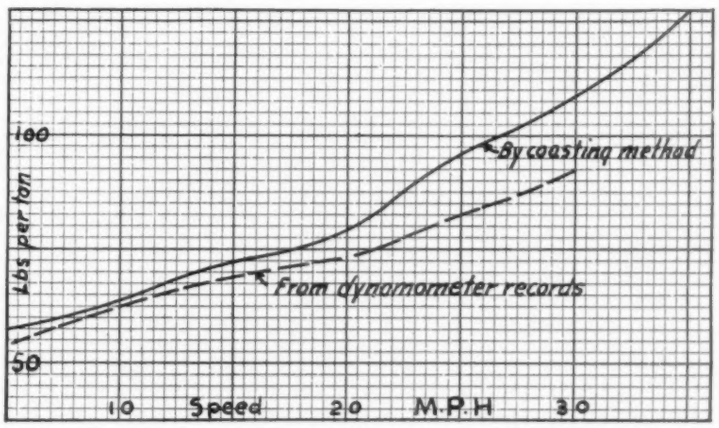


FIG. 17. COMPARISON OF RESISTANCE TO TRACTION BY FIELD DYNAMOMETER AND BY COASTING METHOD.

By means of this sand course an excellent measure of the ability of a vehicle to cross sandy soil can be obtained. It doubtless represents a more extreme terrain condition than would generally be found, but at the same time furnishes accurate information of the ability of one type of vehicle as compared to that of another type of vehicle to traverse soft terrain. The course is long enough to permit the dynamometer to measure the drawbar pulls developed by different types of vehicles (see Fig. 12). The table on page 79 gives the drawbar pulls which different vehicles developed on a dirt course as compared with the pulls obtained in the sand course.

Assuming that the cross-country mobility of a vehicle is proportional to its performance in sand, then the military efficiency of a vehicle

FIG. 18. TRUCK AND ANTIAIRCRAFT GUN MOUNT ON THE SAND COURSE.

Armies Have Been Defeated by Such "Little Things" as Mud!

Fig. 19. Half-Track Car Being Tested on the Mud Course.

Fig. 20. Medium Tank After 5-hour Non-stop Run.

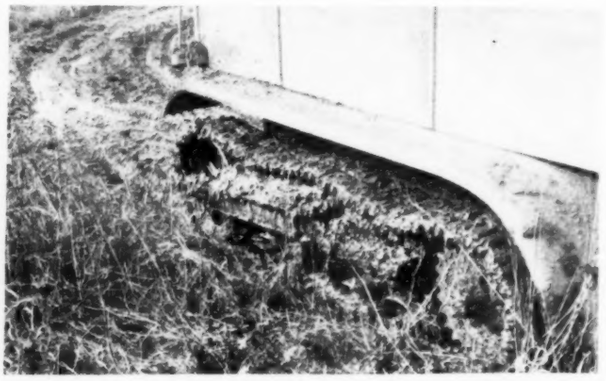


Fig. 21. Half-Track Truck Running in Mud.

Fig. 22. Truck Stuck in Mud Course at Penetration of 18-inches.

FIG. 23. LIGHT TRUCK TOWING GUN CARRIAGE IN THE WATER COURSE.

might be considered related to the ratio of the drawbar pull in sand to the same pull developed on a dirt course expressed as a percentage.

TABLE I

Vehicle	Type	Total Weight as Tested	Pull on Dirt Course	Pull on Sand Course	% Efficiency Ratio Pull in Sand Pull in Dirt	Remarks
Truck	4 x 2	8,100	4,100	0	0	Cannot go through sand course.
Truck	4 x 4	9,900	5,200	900	17.3%	
Truck	6 x 6	14,000	8,100	1,100	13.6%	
Half Track Car	.....	8,850	4,000	2,600	65.0%	
Tractor	Track with grousers	21,000	9,500	8,750	92.0%	Third gear.

We see, that on this basis, a 4 x 2 truck has 0 per cent efficiency as a military cross-country vehicle, since a vehicle of this type cannot propel itself through sand. It is well known that all 4 x 2 automotive vehicles, such as passenger cars, trucks and buses, have practically no dependable cross-country mobility. If the ground is soft the rear wheels quickly cut through the surface until the vehicle becomes immobile. The 4 x 4 vehicle is a much better cross-country type than the 4 x 2 vehicle. The 6 x 6 truck shows a lower ratio than the 4 x 4 truck but actually has equal or greater cross-country mobility. These data demonstrate clearly that the king of all cross-country vehicles is the full tracklayer. While the 4 x 4, 6 x 4, 6 x 6 and half-track vehicles can be used with considerable success cross-country, an army which must have the maximum mobility under all conditions of terrain will ultimately utilize the full tracklayer as its basic vehicle.

THE mud course (Fig. 19) consists of an open concrete box made with a central wall dividing it into two 12-ft. roads 300 feet long by 3 and 4 feet deep. This box is filled with soil from the excavation which is a mixture of loam and clay. A 6-inch pipe placed on top of the central wall runs the length of the course. This pipe is perforated with holes along its length and connected to the water supply. This water system permits sprinkling both roads until the desired degree of muddiness is obtained. Before the mud course was constructed the relative ability of different types of vehicles to traverse muddy terrain was roughly gauged by driving the vehicles into swampy ground. The supporting power of this swamp land depended upon its dryness so that the conditions varied widely from week to week. It was felt that by constructing a special mud course these conditions could be more readily controlled, which has proven to be the case. Before using, water is applied as necessary and the roads harrowed by using a long spike-tooth harrow until a uniform mixture is obtained. The softness of the mud can be controlled by keeping the percentage of moisture in the mud at any desired figure. A sample of the mud from the course is sent to the laboratory and the percentage of moisture determined. In this way, results obtained with one vehicle can be compared with those obtained with another. Different degrees of muddiness can be maintained in different sections of the two roads. The ability of a certain vehicle to pass through mud having a definite percentage of moisture and its penetration can thus be measured.

As in sand, the mobility of a vehicle through the mud course depends upon the flotation area or the number of square inches of projected area of the tires or tracks in contact with the ground. The ground clearance of the vehicle is of first importance, for if the vehicle penetrates until the body contacts the mud it will not have sufficient power to force itself through the mud. The resistance of the mud to penetration increases with the depth and decreases as the percentage of moisture increases. To measure the supporting power of the mud, a plunger having an area of 50 square inches was loaded

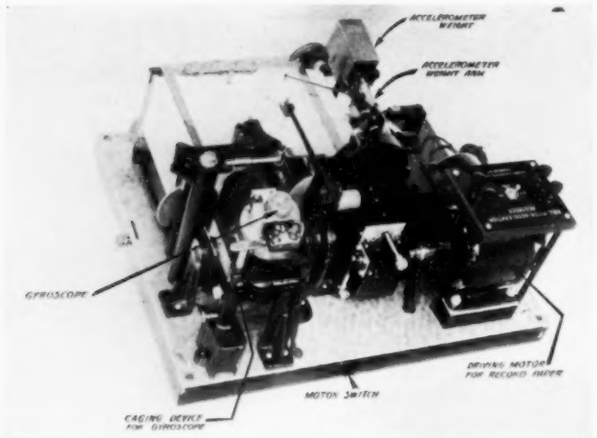


FIG. 24. PITCH, ROLL AND VERTICAL ACCELERATION RECORDER.

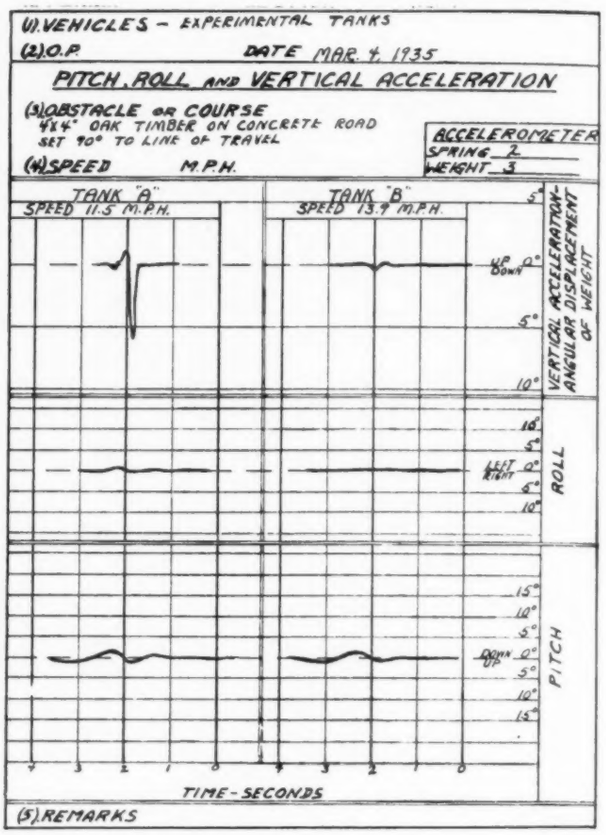

(1) VEHICLES - EXPERIMENTAL TANKS
(2) O.P. DATE MAR. 4, 1935
PITCH, ROLL AND VERTICAL ACCELERATION
(3) OBSTACLE OR COURSE
4"x4" OAK TIMBER ON CONCRETE ROAD SET 90° TO LINE OF TRAVEL
ACCELEROMETER SPRING 2 WEIGHT 3
(4) SPEED M.P.H.
TANK "A" SPEED 11.5 M.P.H.
TANK "B" SPEED 13.9 M.P.H.
VERTICAL ACCELERATION-ANGULAR DISPLACEMENT OF WEIGHT
ROLL
PITCH
TIME-SECONDS
(5) REMARKS

FIG. 25. TYPICAL RECORD OBTAINED WITH INSTRUMENT SHOWN IN FIG. 24.

with weights until equilibrium was just reached. The depth of penetration of the plunger was then measured. Remarkably uniform results were obtained. These experiments are still in progress with indications that considerable data of value concerning the relative mobility of different types of vehicles and the characteristics of tracks required by tracklaying vehicles will be obtained.

As in the case of sand the full tracklaying vehicle is the king of cross-country vehicles as regards performance in mud. Traction devices added to 4 x 4, 6 x 4 and 6 x 6 wheeled trucks greatly improve their performance in mud, but in addition to subjecting the axles of such vehicles to excessive loads, for which they were not designed, such devices leave much to be desired.

THE water course (Fig. 23) consists of a concrete tank 250 feet long by 15 feet wide by 4 feet deep at the center with the bottom gradually sloping towards the center from both ends. This course is used for two types of tests: fording and high speed tests. By placing the vehicle at the center of the tank and gradually increasing the depth of water, the maximum depth of water which a vehicle is capable of fording can be ascertained. For the speed test about one foot of water is placed in the tank and the vehicle driven at high speed, about thirty miles an hour, through the water. At this speed water is splashed at considerable pressure over the vehicle and it is usually driven into the engine compartment, sometimes getting into the distributor and other parts of the electrical system, resulting in stalling the engine or other damage. This test will bring out like deficiencies and point to methods of correction. The high-speed water test also indicates the effectiveness of protection to the driver and crew provided by the body.

The riding characteristics of a fighting vehicle are of first importance not only from the standpoint of comfort of the

FIG. 26. THE CIRCULAR COBBLE STONE COURSE—75-MM. GUN CARRIAGE BEING TESTED.

FIG. 27. MEDIUM TANK CLIMBING 3-FOOT VERTICAL WALL.

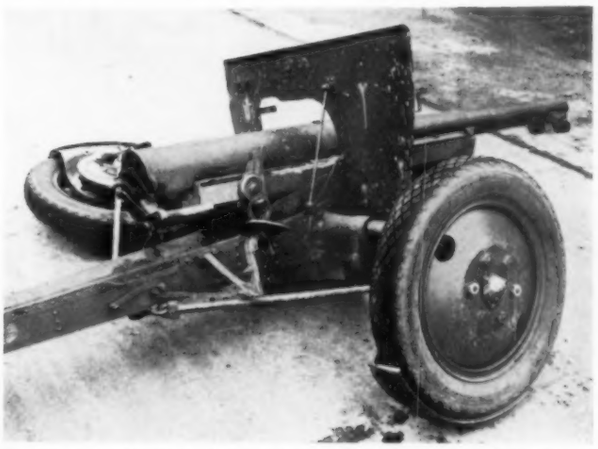


FIG. 28. AXLE FAILURE ON THE COBBLE STONE COURSE.

crew but also of the stability of the vehicle as a gun platform.

The tanks and armored cars in the past have had suspension systems of such limited flexibility that the accuracy of fire from the vehicle when moving has been most unsatisfactory to say the least. In fact until recently it has been more a question of whether the crew could endure the shocks of cross-country travel than concern about the accuracy of gun fire.

The opinions of members of the crew and other observers do not form a satisfactory guide as to the relative stability of the vehicle when moving over rough terrain. In order to determine with accuracy the riding characteristics of different vehicles and relative body stabilities, a special instrument has been developed known as the Roll, Pitch and Vertical Acceleration Recorder, since it measures these movements.

The instrument (Fig. 24) consists of a gyroscope mounted upon gimbals. The angular movements of the instrument relative to this gyroscope, which remains in the same plane, are recorded on a moving paper driven by a small electric motor. These angular movements of the instrument relative to the gyroscope are used to measure the movements of the longitudinal and transverse axes of the body of the vehicle relative to the ground. The vertical movements of the vehicle are recorded by a vertical accelerometer, which consists of a pivoted arm with a weight at the end of the arm counterbalanced by a spring and suitable damping device. Several weights and springs are provided in order that a record of reasonable size, depending upon the roughness of the course. may be obtained. The instrument is also equipped with an electrically driven time and distance recorder of the same type as used and described for the Dynamometers M3 and M4. The speed at which the vehicle is moving is also recorded.

In order that comparable records may be obtained a series of standard obstacles has been constructed of concrete, faced with timbers. In addition to these standard obstacles sections of permanent roads and railroad crossings have been selected as additional standard courses. Timbers of different cross-

FIG. 29. THE CONCRETE WASHBOARD COURSE—LIGHT PRIME MOVER TOWING 75-MM. GUN CARRIAGE.

Test Runs on the Slope Course at Aberdeen

FIG. 30. THE SLOPE COURSE—THE BRAKES STOPPED THIS TRUCK TOWING 3-INCH ANTIAIRCRAFT GUN MOUNT.

FIG. 31. THE SLOPE COURSE—SCOUT CAR ASCENDING 60 PER CENT SLOPE.

FIG. 32. THE CROSS-COUNTRY COURSE—MEDIUM TANK OPERATING IN SNOW.

sections, placed along concrete roads, have also been used as obstacles.

In making tests with this instrument the vehicle is driven over these standard roads and obstacles, at selected speeds, and the records taken, the instrument being placed on the floor at the position occupied by the gunner.

A typical record obtained with this instrument with the tracklaying vehicle is shown in Fig. 25. It will be noted that the pitch of vehicle A amounts to about two degrees while there is little or no roll. There is also considerable vertical movement of the body of Tank A over this obstacle as indicated by the record made by the vertical accelerometer but relatively little in the case of tank B. These vehicles had different types of suspension and tank B is clearly the better vehicle from this standpoint. By making comparative runs at the same speeds, the relative stability of the firing platforms of two vehicles can be determined and in this manner the best type of suspension system for fighting vehicles ascertained. The results obtained by the accelerometer can be checked with those obtained by firing at targets when the vehicle is moving cross-country. Relative firing records are, however, difficult to obtain due to the human factors entering into the pointing and aiming of the guns which are eliminated by the use of this instrument.

THE test of gun carriages, limbers, trailers and similar vehicles usually requires that these vehicles be driven over land long distances in order to determine the strength and resistance to the severe strains imposed by the twisting and racking effects of cross-country travel. To facilitate and to make such tests as nearly standard as possible the circular cobblestone course shown in Fig. 26 was built. The road, in the shape of a bowl, consists of cobblestones set in concrete forming a standard permanent road surface. At the center, a large steel turn-table is mounted on a concrete base. The turn-table consists of the base ring and racer of an obsolete gun carriage. Upon the racer of the gun carriage, a tractor motor and transmission have been mounted and connected with the traversing pinion meshing with the traversing rack of the base ring. A long arm of structural steel is attached to the racer and extends to the center of the cobblestone road. The gun carriage, or trailer, under test is attached to the pintle of this arm. The arm can be driven at any desired speed up to 18 miles per hour at which it is desired to tow the gun carriage, limber, or trailer. If all gun carriages, limbers and similar vehicles are given the same number of hours of test at the same speed, using this apparatus, the relative life and strength of component parts can be determined (Fig. 28). This apparatus can also be employed to test methods of packing ammunition and ammunition components to ascertain whether or not such packing methods are satisfactory for cross-country travel.

THE bridging device consists of a concrete box approximately 15 feet wide by 35 feet long by 4 feet deep with a movable top or lid of sufficient strength to support the weight of heavy vehicles. This top can be moved by means of a hand winch and the gap adjusted to any desired length. The maximum gap is 11 feet 6 inches.

The bridging device furnishes a means of determining the width of gap, such as a ditch, which a tracklaying vehicle can cross. Wheel vehicles cannot cross such a gap as the

FIG. 33. THE CROSS-COUNTRY COURSE—75-MM. GUN CARRIAGE TOWED BY PRIME MOVER.

front or rear wheels would drop into the opening and the vehicle become immobile. The width of the gap which a tracklaying vehicle or tank can cross depends upon the length of the vehicle and the position of the center of gravity. Tanks and other tracklayers may thus be classified as to their bridging ability which is one of the important characteristics of a cross-country vehicle.

The vertical walls shown in Fig. 27 are built of concrete with a concrete floor in front of the vertical walls surfaced with timbers. The timber flooring is used for the purpose of enabling the tank to get a firm grip and forms a permanent platform. The vertical walls are of three heights—1, 2 and 3 feet. The upper section of the vertical wall is faced with timber to enable the track of the tracklaying vehicle to get a bite in the timber. Additional heights can be obtained by adding timbers to the top of the walls. These vertical walls furnish another means of classifying cross-country vehicles. Thus a 4 x 2 wheeled vehicle cannot normally climb a vertical wall going forward, due to the fact that no power can be applied to the front wheels. However, a 4 x 4 or 6 x 6 vehicle can climb a wall of a height about equal to the front wheel radius, provided that no part of the truck strikes the wall in passing over. A good ground clearance is required. A tracklaying vehicle with suitable type of track can climb a relatively high vertical wall, usually only being limited by the length of the vehicle. If a tank or similar vehicle is short and the wall high the tank may tip over backwards in attempting to climb too high a wall.

THE washboard course consists of a number of concrete blocks set at different distances and staggered so that when one wheel is at the top of one block the opposite wheel will be on the level. The height of the blocks also varies, being low at one end of the course and higher at the other. This course, which is shown in Fig. 29, is used to measure the flexibility of the suspension systems of various types of vehicles and the strength and stiffness of the body in resisting distortion. The bodies of some vehicles tested have been so distorted when the vehicle passed over this course as to cause body rivets and bolts to shear. The suspension flexibility of the bodies of some trucks has been found to be so limited that when one wheel reached the top of an obstacle the other wheel would be lifted off the ground so that it would be impossible for the vehicle to proceed farther due to the action of the differential.

A series of roads of different slopes built on the side of an artificial hill is known as the "slope course." Roads with grades of 5, 10, 15 and 20 per cent have smooth gravel surfaces while the 30, 40, 50 and 60 per cent roads are revetted with timbers to prevent washing (Figs. 30 and 31). These roads have sufficient length to allow the vehicle under test to attain a uniform speed in any gear, before the top is reached. An approach road is used so that any desired initial speed can be given the vehicle before the slopes are encountered.

The slopes are primarily used to measure the slope performance of a vehicle, that is, to find the maximum speed that the vehicle can maintain up a certain slope and the most suitable gear to obtain the optimum performance. These data are measured using the accelerometer previously described and shown in Fig. 14. The type of information which can be derived from this sort of test is very significant. The speeds obtained when climbing the different slopes are plotted in terms of per cent grade as abscissa and the speeds as ordinates. The performance curve drawn shows the optimum speed of which the vehicle is capable on various slopes. A 4 x 4 vehicle with 20.7 horsepower weight ratio can maintain a speed of 13 miles per hour on a 20 per cent slope while the same vehicle with a smaller engine has an optimum speed of ten miles per hour on the same hill.

The writer has heard many officers state that a maximum speed of fifty miles per hour is not necessary for military vehicles. However, these same officers would probably hold that a speed of 20 miles per hour on a 10 per cent grade would not be excessive. An engine which is capable of driving a 4½-ton vehicle up a 10 per cent grade at 20 miles an hour can maintain a speed of fifty miles an hour on level roads without difficulty. The size of the engine required for a military vehicle is fixed by the speed performance desired on slopes and by the acceleration on the level and not by the fifty-mile maximum speed characteristic. Military cross-country vehicles require large engines to drive them at reasonable speeds cross-country and over muddy or sandy terrain where steep grades are encountered.

The slope course is also used to test the power of the brakes to hold the vehicle on a steep grade (Fig. 30) to ascertain whether the engine oil system will maintain a suitable pressure and whether or not oil, water, or fuel will escape, when the vehicle is tipped at a steep angle to the horizontal. The slope course may also be used as a check of the values of drawbar horsepower obtained from the dynamometer test. If the weight of the vehicle be known then the drawbar horsepower in any gear developed as the vehicle climbs a slope at its optimum uniform velocity is

$$\text{Drawbar horsepower} = \frac{W \sin b \, V}{550}$$

where W = the total weight of the vehicle, b = the angle of the grade, V = the maximum uniform velocity which the vehicle can maintain on the slope in ft./sec.

Values of drawbar horsepower obtained in this manner check very closely with those obtained with the dynamometer.

These and other tests performed on this group of accurately graded slopes help to complete the picture of the performance characteristics of the vehicle under test.

THE above tests taken as a whole make it possible to classify vehicles as to performance over different types of terrain. It is thus possible to discover whether the vehicle can meet the performance characteristics which have been specified for that type of vehicle.

The strength, ability to withstand shock, and mechanical reliability are determined by driving each vehicle for long periods on non-stop runs over very rough terrain (Figs. 32 and 33). A vehicle may withstand the stresses developed in cross-country travel for a time but all such stresses must be well within the proportional limits of the materials used, if the component parts are to survive repeated shocks. Whether all imposed stresses are within the proportional limits of the several materials can only be determined if such endurance runs are of long duration.

As fighting vehicles become more highly developed mechanically and as the weaknesses found are gradually eliminated, it is to be expected that the Proving Ground tests will become more and more severe. In fact the severity of the Proving Ground tests to which vehicles can be subjected constitutes in itself a measure of the excellence of the automotive matériel tested.

Defense of the Suez Canal

First Phase—Outbreak of War to February, 1915

By Fred. H. Wagner*

OUR literature is replete with what happened on the Western Front during the World War, and some little has been written regarding the Eastern Front, but the occurrences in Asia and Africa have escaped publication to a great extent, except in official books and documents. The present effort is therefore based on the presentation of two actions which, because of their bearing on the fortunes of the Allies, are highly interesting. These are the defense of the Suez Canal and the accompanying Battle of Romani, the latter having put a definite end to the campaign against the canal. The narrative of these two episodes has been prepared from the British official publication "Military Operations—Egypt and Palestine. From the Outbreak of the War to June 1917." This valuable document was compiled by Lieut. Gen. Sir George Macmunn and Capt. Cyril Falls. The book was published by His Majesty's Stationery Office, London, in 1928.

We also have a canal to defend and keep open, and while the conditions are not similar to those related here, it is hoped this narrative will be read with interest and as much of the lesson taught as is valuable in our circumstances be taken to heart for the future.

THIS study is of timely significance. After describing the defense of the Suez Canal during the World War (in this and the next part of his article) Colonel Wagner draws certain analogies to the Panama Canal. Moreover, developments in the Italo-Ethiopian situation emphasize the strategic importance of the Suez Canal as an element of military supply.—EDITOR.

The outbreak of the World War found the Egyptian situation rather complex, since the British occupation of Egypt was based on nothing stronger than an unwritten convention. The British Consul-General was Great Britain's chief representative, and while in theory he possessed no greater authority in the land than did the consular representatives of other states, in practice he was the representative of the Protective Power, or as explained by Lord Milner, "the ultimate authority in the country in all those matters . . . which the protecting power chose for the moment to regard as calling for the exercise of its control." While theoretically Egypt was considered a Turkish province, in reality she was independent of Turkey except in some minor matters. In point of fact, Egypt was far more dependent upon some of the Great Powers than upon Turkey, and her importance in the war about to be fought was immeasurable principally, but not entirely, on account of the Suez Canal on the northeastern edge of Egypt, with Arabia across the narrow stretch of water.

THIS canal, as Germany expressed it, was the "jugular vein" of the British Empire, since it is located between England and India, lying on the direct route which troops from England going east, and those from India, Australia and New Zealand going west, would take; besides this it is the path which carried the greater portion of all trade between Europe and Asia and Australia. It is therefore readily recognized that the canal was a most vital point in the path of communication between the east and the west.

Ages before the canal was even contemplated the Suez Isthmus had been a trade route as well as the route for the armies of antiquity down to Napoleon. The building of the canal greatly increased the importance of this old route since by it the Mediterranean was wedded to the eastern seas. Since 1869, when the canal was opened to traffic, it necessarily impressed its influence on British policy in the East, consequently it gave Great Britain some concern when war broke out. Traditional British policy was based on maintaining the canal's integrity as an open highway, and its occupation gave the Allies supreme advantages. Besides this, the well-equipped ports of Alexandria, Port Said, and in a lesser degree Suez, formed potential bases of inestimable value.

The outbreak of the World War necessitated a much stronger garrison than the usual small force of peacetime occupation, the canal also required naval defense. It had been deemed certain that in the event of war in Europe, Turkey would join hands with the Central Powers, and this possibility presented quite a host of new problems which required immediate solution. In this connection it must be remembered that Egypt was a Moslem country, and besides being her nominal overlord, the Turkish Sultan was also the religious head of the greater portion of the Moslem world. Although Egypt had but very little affection for Turkey, the Sultan's overlordship possessed a certain significance for the people of Egypt, but his position as the head of their religion was of considerably more importance.

Britain's popularity in Egypt had been on the decline for some years, and this despite all the advantages accruing from British occupancy. The Egyptian populace had become obsessed with the thought that an alien nation, differing in both race and religion, had imposed its control on the country. This imaginary grievance was fanned into flame by a portion of the former governing body, who had lost its occupation and prerogatives, and whose public statements were always hostile to Britain.

A further danger loomed in the presence in the Western desert of the powerful and ambitious religious leader, Senussi. While this leader's material interests were greatly dependent upon friendly relations with Egypt and Britain, his religious sentiments placed his sympathy with the Khalifate. The fear therefore remained that should Constantinople proclaim a holy war, the Senussi would no doubt instruct his followers to answer the call which, besides feeding their religious fervor, would give these desert nomads an excellent opportunity to plunder Egypt, the western border of which was quite defenseless.

The Sudan was quiet, and here Britain had no fear of a

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Turkish overlordship. The country was slowly but surely on the road to prosperity, a fact which was exhibited on the outbreak of the war by the remarkable demonstrations of loyalty and devotion offered to the British Governor-General by the populace. The chiefs and religious leaders also soundly denounced the actions of Turkey. This important position occupied by the British in the Sudan was, however, another cause for extreme dissatisfaction in Egypt, because she argued that since the Sudan controlled the headwaters of the Nile, the father of Egypt's economic life, the Sudan should be controlled by Egypt.

WHEN, in August 1914, the holacaust broke over the world, Lord Kitchener, at the time Consul-General in Egypt, was absent in England; Sir Milne Cheetham was acting in his place. The British garrison, known as the "Force in Egypt," about 5,000 men strong, was under the command of Major-General Byng, and General Wingate was Governor-General of the Anglo-Egyptian Sudan and Sirdar of the Egyptian Army.

With the outbreak of the war Britain was compelled to face the fact that the Powers with which she was at war maintained diplomatic representatives in a country occupied by a British military force. However, since the attitude of Turkey was still an uncertain factor, it became imperative to avoid giving these representatives any offence, but at the same time it was impossible to allow enemy representatives to remain, hence they were ordered out of the country. Turkey, however, made no serious protest against this action, but Britain was still faced with the problems of preventing espionage and controlling the numerous resident subjects of Germany and Austria.

The first care of Great Britain was to keep open and protect the canal, its freedom of navigation having been guaranteed by a convention of European Powers in 1888, subject, however, to this not coming into force so long as the British occupied Egypt. In 1904, through an Anglo-French agreement, Great Britain agreed to put the Convention of 1888 into force with several minor exceptions. A French company administered the canal, this company also owned a strip of land on either side of it with several wider stretches for the location of stations and workshops.

The outbreak of war brought a great deal of enemy shipping scurrying for the canal in order to avoid capture on the high seas, but several of the interned ship masters were found to have made improper use of their wireless, and the latter were consequently dismantled. It was, however, eventually decided that the canal presented no right of asylum, and the Egyptian Government ordered the ships out and escorted them with Egyptian forces to the three-mile limit. It can readily be understood that the Suez Canal Company realized its sensitive position, but all difficulties regarding its line of conduct were solved when Turkey formally entered the war. Then the organization and all the ample resources of the canal were placed at the disposal of the Allies.

ONE of the most important duties now devolving upon Great Britain was the protection of the canal from attack by sea, and since on August 15, 1914, the British Mediterranean Fleet joined with the powerful French Fleet under Admiral Boué de Lapeyrére, the command of the Eastern Mediterranean was assured. Several British cruisers immediately passed into the Red Sea for the protection of the southern end of the canal. The British War Office, in conjunction with the military authorities in Egypt, had also considered its defense against a land attack, but until Turkey should proclaim war nothing could be done in this direction, protection against sabotage being the chief precautions taken during August. The defense and internal security of Egypt, however, required the presence of a considerable body of troops in the event of a war declaration by Turkey, but the regular troops of the British garrison were at the same time required to complete the divisions to be sent to France. Consequently, on August 9, the British War Office issued orders for two infantry divisions and a cavalry brigade to be sent from India, but intended eventually for subsequent service on the European battlefields, as quickly as possible. Later advices informed General Byng that he would also have the use of the Bikanir Camel Corps, placed at the disposal of the British Viceroy in India by the Maharajah of Bikanir. Upon the arrival of these Indian forces all the British fighting troops, together with the greater part of the gun and small-arms ammunition in the country, were to be sent to England.

Lord Kitchener, who in the meantime had been appointed to the post of Secretary for War, nine days later wired that the two Indian divisions were to be despatched direct to Marseilles without disembarking in Egypt, and that a Territorial division would replace the British garrison. This was to be followed by another infantry brigade and, if the situation became more acute, permission was granted to retain temporarily one brigade of the leading division. Lieutenant-General Maxwell was ordered to command the Force in Egypt, and Major General Byng was to return to England.

The Egyptian Camel Corps was ordered to the canal on August 31 as a precautionary measure, but at the same time stringent orders were issued that no troops should leave the banks of the canal unless necessary to repel a raid.

Sir John Maxwell arrived on September 8, and on this same day the transports carrying the Lahore (3rd Indian) Division began to arrive at Suez. General Maxwell retained the 9th Brigade in Egypt, and the remainder of the division sailed for France on the 19th. At this time information was received to the effect that soon 100,000 enemy troops would be available in Syria and Palestine for action against the canal.

THE first act of aggression occurred on September 23, when a small body of Bedouins crossed the frontier near Rafah. The reply to this move was the destruction of the wells at Nekhl, 70 miles east of Suez, by a small detachment of Egyptian coastguards. In the opinion of Lord Kitchener the situation appeared so serious that on the 27th, the day on which the East Lancashire Division of Territorials disembarked in Egypt, he countermanded the embarkation of a part of the original British garrison. Kitchener further informed Maxwell that besides the Sirhind Brigade and the East Lancashire Division, which latter lacked two artillery brigades, he was sending two regiments of Yeomanry. Maxwell, however, was not unduly anxious over the situation, and since the garrison had already embarked he did not propose to retain any part of it, hence it sailed on September 30. In the meantime the Sirhind Brigade had been placed on the canal, and the Meerut (7th Indian) Division had reached Aden.

The troops on the European battlefields were, however, being heavily strained, and Kitchener soon pressed for the despatch of even the Sirhind Brigade to that front. Since such action would have depleted Egypt of all trained troops, Maxwell pointed out that the reports received from Palestine

were extremely disquieting. The roads at Gaza, and even at El Arish, within the Egyptian border, were undergoing major repairs, and all enemy frontier posts were being inspected by German officers. It was also reported that a party, disguised as Arabs and carrying explosives, was descending on the canal in the neighborhood of Qantara. To this the War Office replied that a large force for the protection of Egypt was being formed in India under orders to proceed to the scene; that the Sirhind Brigade would be replaced by that of Lucknow, and that the former was to remain in Egypt until the latter arrived. An Imperial Service cavalry brigade, a composite Imperial infantry brigade, both maintained by the Indian States for the service of the Empire, as well as eight other Indian battalions were to embark for Egypt shortly, while three more brigades of native Indian infantry were to follow. Thus affairs in Egypt assumed a better complexion.

October, however, brought with it a worse situation with regard to Turkey, and subsequently signs of excitement made their appearance in Egypt. Here German propaganda worked towards a revolution, and it was reported that Germany's agents were spreading over the country in an effort to foment the natives against the British. Maxwell, however, stated he could find but little evidence to support this report, but he did admit that there were far too many able-bodied German and Austrian reservists all over Egypt. Maxwell placed these at 600 men, with another 200 from the crews of captured ships, and suggested they be all interned at Malta. One day before the end of the month saw all doubts as to action to be taken under these circumstances removed. War was at the door. The GOEBEN and the BRESLAU had bombarded Odessa, Sevastopol and Theodosia on the 29th, and on the following day the British and French Ambassadors to the Porte demanded their passports.

On the last day of October the East Lancashires marched through the streets of Cairo to impress the populace. Turkish subjects deemed prominent or dangerous were arrested and interned. Martial law was proclaimed on November 2. Great Britain and France declared war on Turkey on the 5th. Further trouble faced the British when the Egyptian Government became alarmed over the prospect of assisting in hostilities against the Sultan and Khalif; this not because of any devotion to the Turks, but on account of doubt as to the outcome of the conflict and in fear of Egypt's position in the event of victory by the Central Powers and Turkey. Greece, Bulgaria, Rumania and Turkey were imbued with belief in the invincibility of the Central Powers, and while this belief was not so general in Egypt, it was widespread, and the Egyptian authorities could not escape its influence.

In this situation the Khedive presented the most difficult problem, since Abbas Hilmi had, throughout his reign, opposed the British as much as he dared. He had been in Turkey since the outbreak of the war, and was actively pro-Turkish. Rushdi Pasha, the Prime Minister, was more moderate, but it was impossible to allow this situation to continue. In consequence of these serious conditions the British declared a Protectorate on December 18, and on the 19th the Khedive was declared deposed, and his uncle, Hussein Kamel Pasha, ascended the throne with the title of Sultan. The British representative's title was at the same time changed from Consul-General to High Commissioner. The populace viewed these changes with indifference, while the new Sultan and his ministers cordially supported both the British authorities, the High Commissioner and General Maxwell.

The declaration of war on Turkey caused the Sheikh ul Islam, the chief religious functionary at Constantinople, to issue a decree proclaiming a holy war against the Allies on November 11, and on the 14th the Sultan, as Khalif, proclaimed a Jihad, the final call to all Moslems to defend their faith.

The destruction of the German raider EMDEN on November 9 had quite an effect in Egypt; the disappearance of this sea menace allowed a number of warships urgently required in Mediterranean waters to pass westward through the canal, and the Admiral of the East Indies Station, Vice-Admiral Peirse, rehoisted his flag in the SWIFTSURE at Suez on December 1. This made available an average of four ships, British and French, for the defense of the canal.

In the meantime, the Indian troops destined for the defense of Egypt reached Suez on November 16, and battalions were immediately sent to Ismailia and Port Said, the defences of the canal proper being entrusted to Major General Wilson. The Sirhind Brigade, after being relieved, sailed on the 23rd to join the division in Europe. Maxwell was informed at this time that Australian and New Zealand troops were to be sent to Egypt for training, where they would be available as reserves until their embarkation for Europe.

The next hostile act occurred on November 20, when a patrol of twenty men from the Bikanir Camel Corps, under command of Captain Chope, was attacked by 200 Bedouins at Bir en Nuss, 20 miles east of Qantara, the attackers having approached under a white flag. The patrol extricated itself, but the affair proved that the camel troopers of the Egyptian coastguard, several of whom had been acting as guides to the Bikanirs, were not as loyal as had been expected, since they allowed themselves to be made prisoners in a manner which might well be termed desertion. No further contact was had with the enemy for the remainder of the year, thus allowing time to organize the troops and to prepare proper defenses. The Australian and New Zealand troops arrived early in December, the original Australian contingent comprising one light horse brigade and one infantry division complete with artillery, and that of New Zealand of 2,500 mounted troops, 5,000 infantry and one field artillery brigade, but they were not trained.

THE expected Turkish invasion was a long time making its appearance. This caused Admiral Peirse, with his light cruisers, to harry Syrian ports, principally Alexandretta, Beirut and Haifa, his object being to put a stop to the movement of supplies. Peirse had the DORIS and the ASKOLD, the latter a Russian vessel, at his disposal for this purpose. These raids were successful and justifiable by the usage of war, but they were discontinued in view of the reprisals which the Turks threatened against such Allied subjects as should fall into their hands. The next move was consequently up to the enemy.

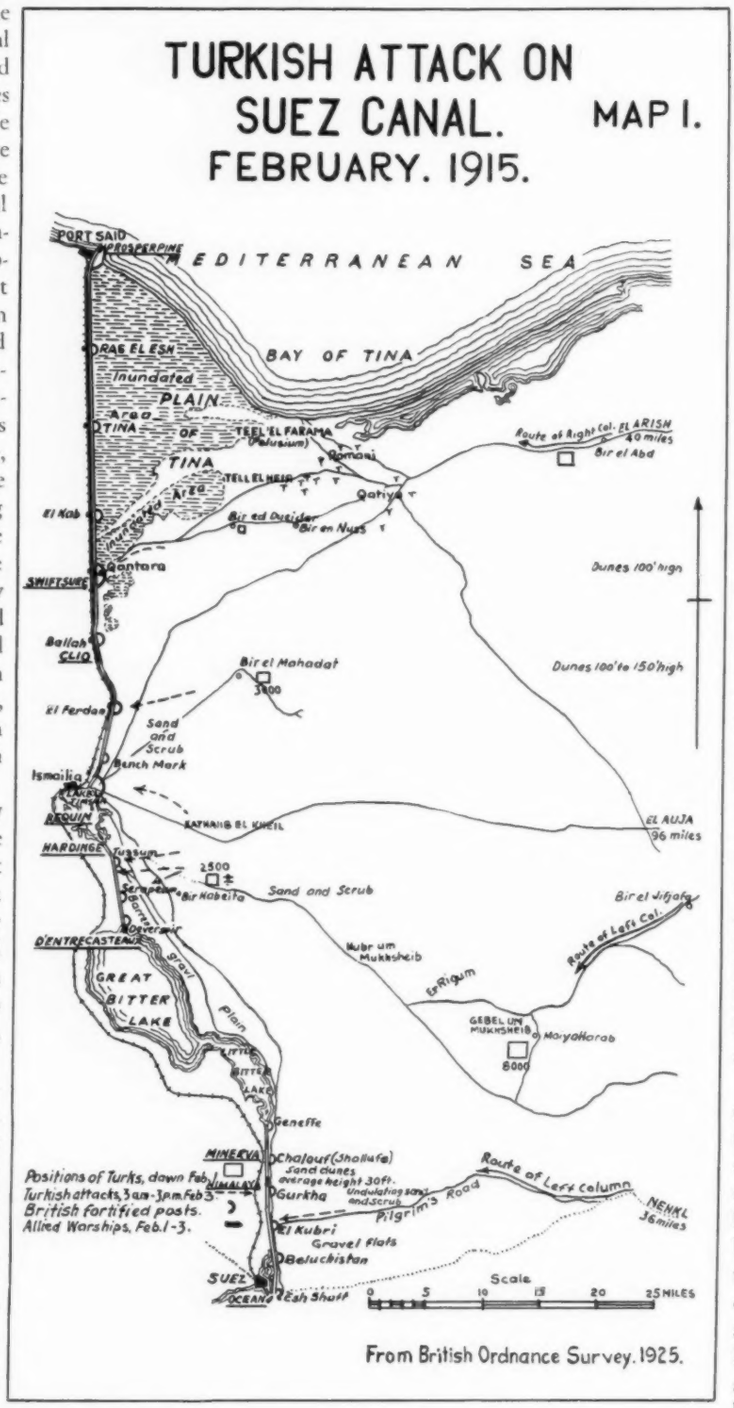
The defenses of the canal were organized by December, the force entrusted with its keeping being made up of the 10th and 11th Indian Divisions and the Imperial Service Camel Brigade. The normal allotment of one British battalion to each Indian Brigade had to be abandoned owing to the demand for the British Regulars in Europe, consequently the two divisions were composed entirely of Indian troops. The artillery which accompanied these troops consisted of three mountain batteries only. The Canal Defenses were consequently increased by two artillery brigades from the East Lancashire Division and a pack-gun battery from

the Egyptian Army; however, the chief reliance for the canal's artillery defense depended upon the presence of warships in its waters.

The defenses were divided into three sectors (Map 1): from Suez to the Bitter Lakes; from Deversoir, north of the Great Bitter Lake, to El Ferdan, and from there to Port Said. The headquarters of the defense and the general reserve were established at Ismailia, on the shores of Lake Timsah, while small detachments were stationed to guard the Sweet Water Canal (Map 2) and in garrisoning the important supply depot established at Zagazig on the main line between Cairo and Ismailia. Only the artillery of the East Lancashire Division was employed at this stage, since Maxwell was averse to stopping the training of these troops. The East Lancashires and the Australians and New Zealanders were placed in a reserve which could be swiftly brought from Cairo to Ismailia by rail, and despatched from there in either direction along the canal.

First-line transport only was supplied to the troops, but in January it was decided to form a second-line transport by means of a small camel corps; this resulted in the assemblage of 500 camels at Abu Sueir, near Ismailia.

The Suez Canal presented an obstacle which, in any case, would have been a serious one to any army approaching it, but it was even more of an obstacle for any force compelled to drag artillery and bridging train across the sands of a wide desert. However, it had always been obvious to all students of the situation that any Turkish attack launched from Palestine should be met and fought on the line of the canal. This view was strengthened through the assistance offered by warships in the canal, since the latter could prevent an attack on Egypt by an enemy landing at either Suez or Port Said. There was, however, another viewpoint to be considered, because any interruption to navigation through the canal, something which was inevitable during an attack, would mean a loss of time which might have serious results during a period when both troops and supplies were urgently required, and when Allied shipping could not spare an hour unnecessarily. The sinking of a ship in the canal, a dangerous possibility in the case of any canal, would be a serious matter. Even though the enemy might meet with only temporary success it would be possible in a few days for him to cause damage which would entail the labor of weeks for repair, during which there would be no passage of ships through the canal.



The defensive work established along the canal at this period, early in 1915, was very simple when compared with the elaborate and extensive system constructed in 1916. The defenses along the east bank consisted of trenches revetted with sand bags and protected by barbed wire, principally to cover ferries and to provide facilities for local counter-attacks. These posts were established (Map 1) at Port Said, Ras el Esh, Tina, El Kab, Qantara, Ballah, El Ferdan, Bench Mark, Ismailia, Tussum, Serapeum, Deversoir, Geneffe, Shallufa, Gurkha Post, El Kubri, Beluchistan Post and Esh Shatt.

The principal works carried out were, first, the laying out and construction of trenches on the west bank and of bridgeheads on the east bank. Next, there was the bridging, which included the construction and operation of lighter bridges at El Qantara and El Kubri, a boat bridge at Ismailia Ferry Post, and eight bridges over the Sweet Water Canal. The Engineer units were also employed on the construction of airplane hangars, the delivery of filtered water to the camps at Moascar, Ismailia and Suez, the distribution of filtered water by boat from the Canal Company's filters at Port Said, Ismailia and Suez to the posts on the canal, the cutting of

the canal bank to permit of inundations, the preparation of maps, and the installation of searchlights for the armored train and at Qantara, Ismailia Ferry Post and El Kubri.

The Suez Canal Company, which had placed all its resources, including small craft, at General Wilson's disposal, rendered great assistance in the construction of works and crossings. Three floating bridges were assembled; the heaviest was located at Ismailia and the lighter ones at El Kubri and Qantara. The cutting was made in the canal bank at Port Said on November 25, and this flooded a portion of the desert in order to narrow the frontage open to attack. The plain eastward of this point is very low, hence the resulting inundation went as far as El Kab, to the north of Qantara, thus effectively barring approach to the canal for a distance of 20 miles. The water subsided somewhat in January, but the inundated area remained impassable for some months longer. On January 2 the Asiatic bank north of Qantara was also cut, thus giving protection to the flank of that fortified zone.

WHEN war was declared by Turkey the Turkish Fourth Army, which had its headquarters at Damascus, consisted of some 60,000 troops with 100 guns, with the VI Corps in the north, its headquarters at Adana, and the VII Corps in the south, the latter's headquarters being at Damascus. This army had been mobilized since August 2. The Turkish troops had always been formidable opponents, and they were still considered so, but they had not fully recovered from the demoralization and disorganization which had followed upon the Balkan and Tripolitan Wars. The troops closer to Constantinople, where they were under the influence of the German military mission, were in better spirits, but these were quite some distance from Egypt.

Maxwell's problem, however, was not so much concerned with the number of troops Turkey could place in Syria, but rather with her power to cross the desert between the frontier and the canal. Egypt was watchful and fairly well informed in the circumstances. The British airplanes were incapable of long flights, but the French sea-planes, which had been placed at Maxwell's disposal, were better, although not nearly powerful enough for the work demanded of them. From information obtained by the air forces and from reports made by agents, it was recognized that the attack would materialize soon, and it was also almost certain that the attack would be launched through Central Sinai. British headquarters also knew that a large force, including the 10th, 23rd and 27th Turkish Divisions, was assembled close to the frontier, near Beersheba.

The trenches on the west side of the canal were unoccupied until January 22, and then only by small detachments. On the 26th reports were received to the effect that a force of some 6,000 men was in occupation of Moiya Harab, 25 miles east of Little Bitter Lake, while 40 miles to the northwest the British covering troops exchanged fire with an enemy force in front of Qantara, where the enemy fell back in the afternoon. It was then decided to occupy all defensive positions at once.

The 32nd Indian Brigade furnished two battalions for the trenches along the west bank from Bench Mark Post, north of Lake Timsah, to Ballah, with Brig. Gen. Watson in command. The trenches all along the front on the west bank were reinforced from local reserves. The New Zealand Brigade arrived from Cairo on the same day, and the Otago and Wellington Battalions were despatched to El Kubri in the First Sector, while Brigade Headquarters with the Auckland and Canterbury Regiments detrained at Ismailia, at which point they were held in reserve. The Navy also furnished its defensive quota when the SWIFTSURE, CLIO, MINERVA, OCEAN and the armed merchant cruiser HIMALAYA entered the canal and took stations at Qantara, Ballah, Shallufa, Gurkha Post and Esh Shatt, respectively, the French coastguard ship REQUIN being stationed in Lake Timsah.

The enemy was found on the next day to have established himself astride the El Arish—Qantara road, 5 miles east of Qantara, in the Third or Northern Sector. In the early hours of the morning the enemy advanced on the canal in the First or Southern Sector, where he delivered slight attacks on the Beluchistan and El Kubri posts. General Wilson, however, realized that these attacks were only feints, and was confident that the main attack would be launched at some point in the Second Sector, hence he reinforced Serapeum, its central post, with the 2nd Rajputs from Moascar.

The French cruiser D'ENTRECASTREAUX and the PROSPERPINE now also appeared in the canal, the former taking station just north of the Great Bitter Lake, with the PROSPERPINE at Port Said. The Royal Indian Marine ship HARDINGE took station on February 1 just south of Lake Timsah and north of Tussum. It will be seen from Map 1 that the ships defending the Second Sector were stationed either at the extremities of the section of the canal forming it, or, in the case of the REQUIN, in Lake Timsah, because, owing to the height of the bank about Tussum, it was only from these points that they could bring oblique fire to bear upon an enemy advancing on that front. In order to avoid serious interruption to traffic, the canal was now closed each night and reopened in the morning.

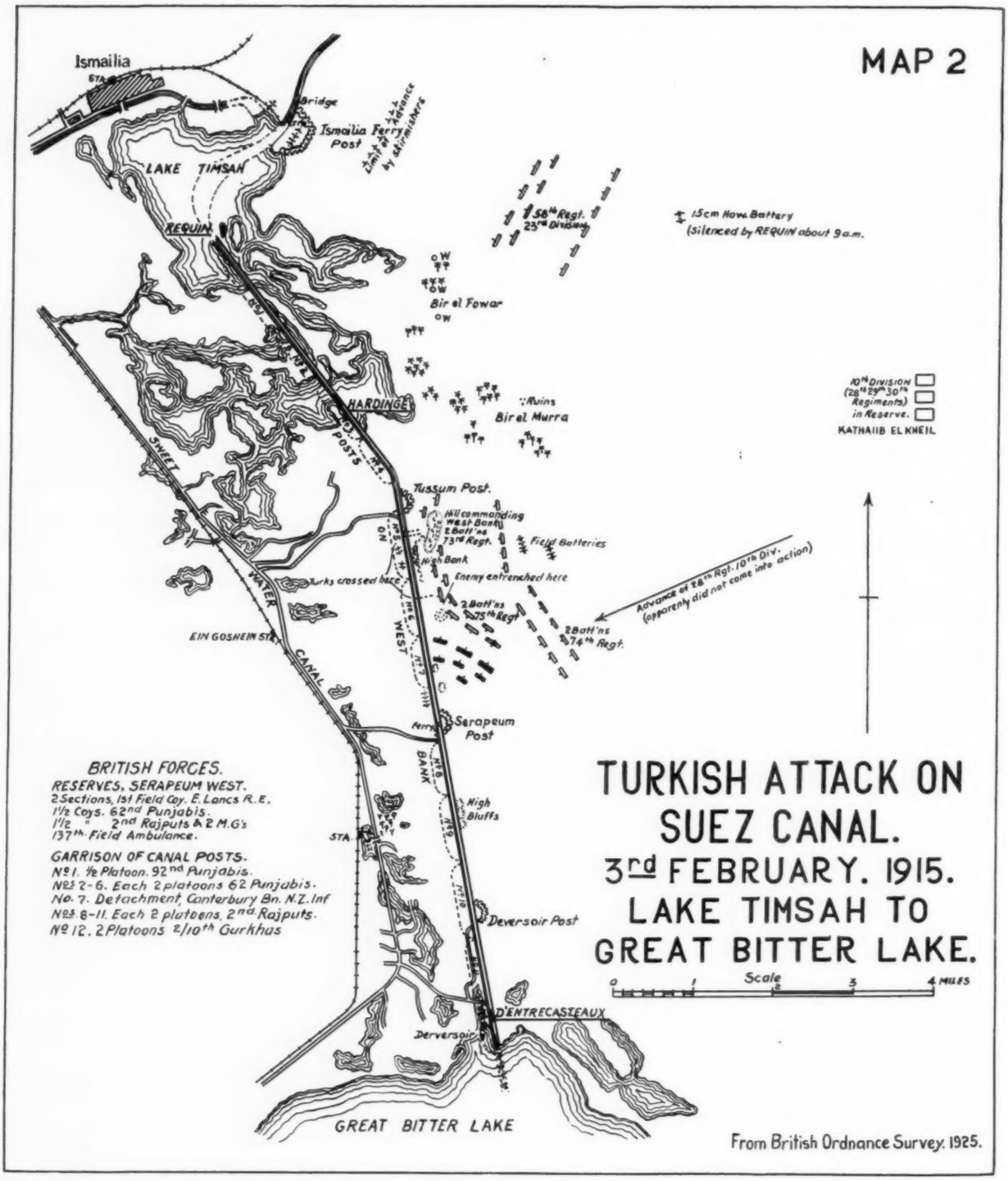
Matters were approaching a climax when airplanes, on the 28th, observed a force of between 3,000 and 4,000 men about 8 miles east of Deversoir in the Central Sector, and on the 29th this force had been increased considerably. During an enemy reconnaissance on the morning of the 28th against the Qantara bridgehead, on the east bank, the Sepoys of the 14th Sikhs and the 1st/6th Battalion of the Gurkhas, stationed in that post, received six casualties, while the Turks left three dead in front of the wire, but they dragged away several wounded.

The stage was all set on January 30 when the enemy closed in generally, making his heaviest concentration east of Bir Habeita, about 9 miles east of Serapeum. He had failed to disguise his intentions, and General Wilson awaited the main attack on his Second or Central Sector with sufficient forces deployed on the canal, supported by strong reserves.

JANUARY was now at an end, and the British troops in the posts along the canal were ready for the attack, which was expected at any moment, having had ample warning of its approach. All were imbued with confidence as to the result.

On February 1 the disposition of the enemy forces, so far as could be discovered, were: At least 2,500 men with apparently two guns at Bir Habeita 6 miles east of Serapeum; about 8,000 men at Moiya Harab, 30 miles to the southeast, in a position which indicated readiness to reinforce the body at Bir Habeita or to strike a blow at the First Sector in the neighborhood of Shallufa, and about 3,000 men further north at Bir el Mahadat, 10 miles E.N.E. of El Ferdan. The Turks had also dug a line of trenches 5 miles northeast of Qantara, but these now appeared to be empty, while to the rear, at Bir ed Dueidar, only about 300 men could be observed

despite a luxuriant palm grove at this oasis which was capable of concealing many more. Also to the rear, on the northern Sinai route at Bir el Abd, 40 miles east of the canal, and at El Arish on the Palestine frontier, as well as on the southern



route at Nekhl, there appeared to be considerable concentrations of Turkish troops.

On this same day the Turks pushed slightly ahead opposite the Ismailia Ferry Post; this resulted in reinforcing the bridgehead at that point, as well as at Bench Mark Post, 2 miles to the north. Still a little further north the guns on H.M.S. CLIO, from her station near Ballah, scattered small bodies of the enemy in the desert east of El Ferdan. Patrols from Ismailia Ferry Post on the morning of the 2nd discovered a further advance had been made by the enemy opposite that point during the night. This resulted in the moving out of small detachments from the Post. Contact was made with the enemy and the action continued until about 3:30 P. M., when it was stopped by a high wind which grew stronger every hour, whipping up the sand until the troops found themselves almost in darkness, making aërial reconnaissance impossible. The enemy had exhibited no immediate intention of coming to close quarters, and he apparently intrenched

himself in the evening at a point about 2.5 miles southeast of the British defense lines. Contact with the enemy had also been made along the whole 20-mile front from Deversoir to El Ferdan by the British outposts during the day. The CLIO also again came into action and drove enemy groups out of range of her guns.

The British were now positive that the attack would be launched against the Central Sector, but there was no indication as to whether the main blow would be directed north or south of Lake Timsah. Reinforcements, however, were sent to El Ferdan; these consisted of an armored train with four platoons of New Zealand infantry, and two platoons to support the 5th Gurkhas in the post on the east bank. This portion of the Sector, between Great Bitter Lake and Lake Timsah, was now manned by: 19th Lancashire Battery R.F.A. (T) (four 5-pdrs.); 5th Battery Egyptian Artillery (four mountain guns and two Maxims); 1st Field Company East Lancashire Engineers (T) (two sections); 22nd Indian Infantry Brigade, less 3rd Brahmans (62nd and 92nd Punjabis, 2nd/10th Gurkha Rifles); 2nd Q.V.O. Rajputs; two platoons 128th Pioneers and 137th Indian Field Ambulance.

SIX companies were on the east bank of the canal; two of the 92nd Punjabis in the Tussum Post, two of the 92nd in that at Serapeum, and two of the Gurkhas at Deversoir. There were eleven posts on the west bank, each held by two platoons with each platoon covering a front of some 600 yards with three sentry posts 200 yards apart. There were three companies in reserve at Serapeum. With the first indication of the expected attack a company of the 62nd Punjabis was ordered up from Serapeum to the danger point, or Mile-Post 47.4, a little south of Tussum, and which was subsequently reinforced by six platoons of the 2nd Rajputs.

The sand storm failed to abate during the early part of the night, and the Indian sentries peered out into the darkness with their faces screened in their puggarees, while their rifle breeches were wrapped in rags, but they saw or heard nothing until about 3:25 in the morning of February 3rd, when an observation post at Tussum heard troops passing southeast of the post towards the canal bank. A few moments later loud shouting and howling broke out south of the post; this noise, in defiance of strict orders, was made by Turkish Irregulars, the "Champions of Islam," calling upon Allah and adjuring the attackers to die for the faith. Major Maclachlan, who commanded at the post, moved a machine gun and a half platoon down to the southern flank of the post to rake the east bank. This stopped the shouting, and the enemy replied with ineffective machine-gun fire.

There was still nothing to be seen, but suddenly the moon, two days past full, broke through the clouds and brought into view dark masses moving slowly down the gullies on the east bank towards the canal. These masses were discovered to be pontoons and rafts carried by squads of men. The Egyptian battery, which had moved to this point on the previous day and had dug in on the top of the high west bank, opened fire at 4:20 A. M. with splendid results, since it soon became evident that the first two pontoons had been abandoned by the carriers. Rifle fire from the 62nd Punjabis and the 128th Pioneers at Post No. 5 assisted the battery, and most of the attempts to carry the craft to the water were checked.

It is not known whether the Turks had selected this point for making their first crossing of the canal, or whether the other detachments moving towards the canal had been delayed in the darkness by the rough character of the terrain. However, a few minutes later other troops carrying pontoons were observed on the east bank on a front of 1.5 miles a short distance north of the point of the first attempt. The rapid fire from the British lines caused most of these craft to be abandoned before reaching the canal, while those which had been launched were quickly holed and sunk.

Only three pontoons managed to cross the canal under cover of heavy machine-gun and rifle fire poured out by the Turks lying on the sand dunes close to the east bank. A boat load of the enemy managed to land opposite mile-post 48.3 to the south, on the front of Post N. 6. This party was immediately charged with the bayonet by a small force commanded by Major Skeen, and all were killed or wounded. The other two boat loads managed to make a landing at the original point opposite mile-post 47.6; this party had barely landed before it was attacked by a small detachment of the 62nd Punjabis and the 128th Pioneers from Post No. 5 under command of Captain Morgan and Lieutenant FitzGibbon. Both these intrepid officers were wounded, the latter mortally, in spite of which he ran a considerable distance with a message to the Egyptian battery, the escort of which he commanded. The Turks had six killed and four wounded, while about twenty escaped and hid under the west bank, where they were found and captured by a party of the 2nd Rajputs. These small parties, with their gallant attacks, were the only Turks who managed to cross the canal, except as prisoners, during the course of the war. Six months later, however, a few raiders swam the canal near Qantara and placed dynamite on the railway, but this did no damage.

ENEMY fire from the east bank of the canal was intense and well directed, causing casualties among the defenders to mount up. As daylight came it was quite obvious that the enemy had been handled quite roughly. His pontoons, which were of German service type, made of galvanized iron and capable of holding twenty men each, as well as his rafts and other abandoned materials littered the east bank, along which also were found many Turkish dead. This surprise crossing, in an endeavor to invade Egypt, had ended in complete failure. The rafts abandoned by the Turks were made of a light wooden framework about 15 feet long and 12 feet wide, filled with empty kerosene cans.

The attack had not been abandoned, however, and with the brightening day the enemy launched an attack against Tussum Post while delivering heavy artillery fire against the British positions, the warships stationed in the canal and the merchant ship moored in Lake Timsah. The HARDINGE and REQUIN, however, were not quiet, but opened fire on parties of enemy infantry in the desert as soon as advancing daylight made them visible, and by the time full daylight appeared the action became general. The Turks were discovered holding a trench some 200 yards south of Tussum Post, facing westward, but flank fire from the machine guns in Tussum practically destroyed this party. An enemy body, some 350 men strong, was discovered to have made lodgment in the British day-trenches to the east and south of Tussum. A counter-attack, led by Captain Rigg, 92nd Punjabis, was launched at 7 A. M. from the southern flank of the post. This force succeeded in recapturing a portion of the trenches and took 70 prisoners. A further counter-attack was made at 11 A. M. against the day-trenches by a party led by Lieutenant Thomson-Glover, of the 35th Sikhs but attached to the 92nd Punjabis; this attack came from

the northern end of the post, and was completely successful, but it was 3:30 P. M. before all the trenches were regained. During these actions several Turkish officers and 280 other ranks were captured or killed, and a quantity of material was taken in the trenches.

At 6:30 A. M. the commander of the 22nd Indian Brigade, Brig. Gen. Geoghegan, observed there was no sign of a pending attack south of Serapeum, consequently he decided to collect at that point sufficient troops to drive out of the trenches and sand hills the Turks still in front or south of Tussum Post. He moved up two companies of the 2nd/10th Gurkhas, with their machine guns, from Deversoir to Serapeum, where they joined six platoons of the 2nd Rajputs. At 8:40 A. M. two platoons of the Rajputs and two companies of the 92nd Punjabis, from their post on the right, crossed the canal by ferry and advanced up the east bank towards Tussum. This movement, when discovered by the Turks, caused the latter to break in surprisingly large numbers from the sand hills and hummocks in the neighborhood of the point from which their southern boatload had crossed the canal during the night. Simultaneously, however, a considerable Turkish force was seen coming into the open some three miles to the northeast; they deployed, supported by two batteries, and began an advance on Serapeum Post. This enemy force was the 74th Regiment, 25th Division, the other two regiments, the 73rd and 75th, of that division having already been committed to the attack on Tussum Post and the canal immediately south of it. Djemal Pasha's reserve, consisting of the 74th Regiment, 28th Division, and the 10th Division also began to advance, but how close they ever got to the canal has never been ascertained.

THE British counter-attack was unable to make headway against this superior force. The Rajputs, while advancing along the canal bank, came under severe fire and lost their commanding officer before they were brought to a standstill. In the meantime the Punjabis had concentrated on the right to face the enemy attack, while six platoons of the 2nd/10th Gurkhas moved up in support, the entire force on the east bank being under the command of Lieut. Col. Sutton of the 2nd/10th Gurkha Rifles. This small force firmly held its ground and its determined front caused the Turkish attack to come to a stop, never having approached the British line closer than 1,200 yards.

There was considerable potential danger in the abandoned pontoons scattered along the eastern bank of the canal, since there was always a possibility of again employing these after the fall of darkness if it were possible for the enemy to again establish himself in force upon the bank. Brig. General Geoghegan therefore, at 7:45 A. M., requested Lieut. Commander Palmes, R.N., who was in command of torpedo boat *043* at Deversoir, to destroy these. The torpedo boat moved up the canal and fired two 3-pdr. rounds into each pontoon. He then landed to see if any others were hidden behind the east bank; he found two more and blew them up. He finally almost walked into a trench full of Turks, but succeeded in regaining his dinghy and pulled back to his boat.

While these two attacks were in progress another Turkish force, the 68th Regiment, 23rd Division, was found advancing from the southeast, thus threatening Ismailia Ferry Post on the south side of Lake Timsah. This attack was never seriously pressed, the advance troops being satisfied to entrench themselves some 800 yards from the canal defenses. The accompanying artillery, consisting of two field batteries, supported by a 15-cm. howitzer battery far out in the desert, soon became a real menace. The fire from these guns was directed against the HARDINGE. The first shells fell short, but at 8:15 A. M. they began to straddle the ship, and a ricochet soon carried away the wireless aërial. A few minutes later a high-explosive shell struck the forward funnel, followed by another hit at the base of the after funnel; then came a shell from one of the heavy howitzers, and this burst above the fore part of the HARDINGE and caused several casualties among the gun crew. Next the steering gear was damaged and the fore stokehold was rendered untenable. Commander Linberry knew by this time that the Turks had his exact range, and that if he remained in his present position he would subject his ship to the considerable risk of being sunk in the channel, and this was easy to accomplish since she was not armored, hence highly vulnerable. The HARDINGE therefore slipped her moorings at 8:45 A. M. and proceeded to an anchorage in Lake Timsah, outside the fairway. The howitzers sent three or four more shells after her and then sought another target. The object of the Turks to sink her in the channel was thus frustrated.

THE artillery defense of Tussum now depended largely upon the guns of the REQUIN, the only warship in the area with the exception of the armed tug MANSOURAH and torpedo boat *043*, but these were armed only with light guns. A berth for the REQUIN had been chosen and dredged out some time previously, and her commander had made preparations for the defense of the sector by placing numerous range marks in the desert, thus, in fact, making her a floating battery. The REQUIN had been searching for the enemy field artillery while at the same time shelling small groups of infantry in front of Ismailia Ferry Post with her 10-cm. guns. Suddenly she came under the fire of the howitzers which had previously engaged the HARDINGE. It seemed impossible to locate the enemy battery, the fire from which momentarily became more and more accurate, and presently it straddled the ship and the situation became uncomfortable. Since the 10-cm. guns had no protection it became necessary to remove the crews beneath the shelter of the steel deck, and at the same time steam pressure in the boilers was increased so as to quickly move the ship in case she had to shift her position. The only gun remaining in action was a 27.4-cm. in a turret. At 9 A. M. a large shell fell near the REQUIN, but at the same time a puff of smoke was observed in the desert; this was rightly assumed to have come from the Turkish howitzers, which were then estimated to be about 9,200 meters distant. The 27.4 accordingly opened fire at ranges between 9,000 and 9,500 meters. The third shell was followed by a cessation of howitzer fire, and this was not again resumed. Thus was a serious menace to the canal suddenly removed.

The REQUIN now turned her attention to the desert opposite Tussum and Serapeum, in which she was supported by the cruiser D'ENTRECASTEAUX, the latter having received orders to move up and replace the crippled HARDINGE. These orders were subsequently cancelled when word came that the flagship SWIFTSURE was on the way from Qantara to carry out that task. The D'ENTRECASTEAUX consequently moved about three-quarters of a mile to north of Deversoir, where she was ordered to assist in repulsing the attack on Serapeum. The bursting of the REQUIN's shells at that point could be seen from the deck of the D'ENTRECASTEAUX and she opened fire with her 14-cm. guns on the same point; the cross fire from the heavy guns from these two French ships was thus directed

on the area where the Turk was deploying his forces. There is no doubt but that the moral effect of the melinite on the Turkish troops called a halt to their advance.

The Turks had suffered a definite repulse between Tussum and Serapeum, but they maintained intermittent artillery fire until 2 P. M. Silence followed, and it was assumed the enemy had definitely broken off the action. This assumption was strengthened when it was seen that bodies of Turks were moving eastward, their movements being hastened by the 24-cm. shells from the D'ENTRECASTEAUX. Lieut. Col. Sutton's force, which had attempted to carry out the counter-attack, now withdrew to its former station north of Serapeum. A half hour later a small body of the enemy was discovered again in occupation of the ridge which it had previously evacuated, but the British artillery soon drove them off. Fire from enemy artillery persisted opposite Ismailia, where numerous shells fell in the bridgehead and camp but no casualties resulted. A battery firing on the shipping in Lake Timsah was silenced at 3:30 P. M. by fire from the REQUIN.

At 4:30 P. M. reinforcements of the 31st Indian Brigade began to arrive but they were no longer needed. They were, however, placed in positions of close support at various points, since it seemed possible that the offensive would be renewed. The command of the front between Great Bitter Lake and Lake Timsah was now taken over by Maj. Gen. Wallace, the commander of the 11th Indian Division. The HARDINGE was replaced by the SWIFTSURE, the OCEAN moved to this part of the front, and the HARDINGE was sent to replace the SWIFTSURE at Qantara. Reinforcements consisting of headquarters, 2nd Australian Brigade, with the 7th and 8th Battalions, Australian Infantry, arrived in Ismailia during the evening. Everything was thus prepared for the attack expected to materialize the next morning. Except for some rifle fire from the east bank south of Tussum, the night was quiet.

ATTACKS made on the canal at other points were of little importance and they were nowhere pressed with sufficient energy to produce any anxiety regarding the Turk's real plan. No contact was made with the enemy at Suez, but some fire was exchanged between a small enemy detachment and the post located on the east bank at El Kubri; the enemy, however, withdrew. The infantry attack at El Ferdan, the northernmost post of the Second Sector, was quite feeble; some firing had occurred on this part of the front before dawn, and with the coming of daylight two lines of trenches were discovered about 2.5 miles from the canal. The CLIO opened fire on these. Two enemy field guns began a bombardment of the railway station soon after 9 A. M., and they made several direct hits. These guns were located by the CLIO within thirty minutes, but this drew the Turkish fire on her. The CLIO received two hits, and some little damage was done to one of her guns, but there were no casualties among her crew, and she silenced the enemy by 10:30 A. M. Observing that bodies of the enemy were falling back towards the northeast, the CLIO gave them her attention and greatly assisted the retreat.

There was a rather strong attack on two piquets from the 89th Punjabis at Qantara, in the Third Sector, between 5 and 6 A. M.; but the heavy machine-gun and rifle fire from the piquets caused serious loss to the enemy when he came up against the barbed wire. He was then driven off with little difficulty. Thirty-six Turkish prisoners were subsequently brought in at this point and twenty dead were found outside the wire. The enemy loss was larger than this, since he was observed carrying dead and wounded with him when compelled to retire.

All these feint attacks consequently failed entirely, very little resolution having accompanied them. It was known that there were further enemy detachments in the Suez Sector near posts other than El Kubri, but they never came within range of machine-gun fire from the Beluchistan, Gurkha or Shallufa posts.

The garrison of the Central Sector confidently expected a renewal of the attack on the 4th, but daylight showed that the bulk of the enemy force had disappeared. Some snipers south of Tussum Post, near mile-post 48.3, had been firing during the night, hence Captain Cochran was ordered to take two companies of the 92nd Punjabis from Serapeum Post and advance north to clear the area between it and Tussum. He proceeded along the bank with one company, the other being extended widely on his right to cut off retreat to the east and northeast. He reached a hummock at 8:40 A. M. and, upon ascending the latter, his company came under the fire of an enemy force some 120 yards away. His men went prone and returned the fire. Five minutes later some fifty of the enemy jumped up from their trench, holding their rifle butts up, while one who appeared to be an officer waved what looked like a white flag. Captain Cochran advanced toward them, signalling them with his hand to come over; a few unarmed Turks responded. Suddenly the remainder started firing again and several Sepoys fell. There was, however, never any evidence produced which would mark the act one of deliberate treachery. Captain Cochran's advance had been watched by Major Howard, of the 22nd Indian Brigade, and he observed that the Turks were in considerable force and strongly entrenched. Howard galloped back to Serapeum and reported what he had found, upon which a company each of the 27th and 62nd Punjabis and 128th Pioneers, under the command of Major Machlachlan, were despatched to Cochran's assistance. A fierce fight of about an hour followed, but the enemy surrendered just as the British were about to charge them. Six officers and 292 men, 52 of the latter seriously wounded, were captured by the British; three machine guns also were taken. The dead in the Turkish position numbered 59, one of the latter being Hauptman von dem Hagen, a German staff officer who had supervised the attack.

The trenches opposite Ismailia and Qantara were found deserted. At noon on the 4th Brig. General Watson, with his own brigade, two infantry battalions and an Indian mountain battery, moved out from Ismailia Ferry Post on reconnaissance. He located a body of the enemy, estimated at between three and four regiments, seven miles northeast of Tussum, but could find no sign of a general retreat, although further north he observed a body of infantry moving eastward. The reconnaissance returned to the post after taking 25 prisoners and 70 camels, a part of the Turkish water column.

Aërial reconnaissance on the morning of February 5 discovered that the enemy opposite the Second Sector was concentrated in his old camp east of Bir Habeita. Several bombs were dropped on this camp. Later this force was seen to deploy and advance some distance as if about to renew the attack, but it passed out of sight into a valley and was not seen again. To the north the Turkish right column was seen withdrawing through Qatiya, on the Mediterranean route. To the south, seven miles northeast of Esh Shatt, a small detach-

ment of New Zealand infantry, the 2nd/7th Gurkhas, a squadron of Imperial Service Cavalry, and a battery of East Lancashire Artillery, encountered a body of about 100 of the enemy, but this force fell back at the British approach. On February 6 mounted patrols from Qantara found that the Turks had evacuated Ed Dueidar, but were fired on by Bedouins. A regimental camp was found at Rigum, east of Great Bitter Lake, and another southeast of it at Moiya Harab. By February 10 the only enemy reported in the neighborhood of the canal was a body of 400 men at Rigum.

IT will be noted that no counter-offensive was launched on the morning of February 4, when it was learned that the Turks had retreated from the neighborhood of the canal. This was due to the unfortunate impossibility of taking the opportunity for destroying the Turkish central force. Although there were 70,000 troops in Egypt at this time, those highly trained were only the Indian infantry brigades, and not all of these. Besides it was imperative that considerable forces be retained in Cairo and elsewhere. The only means for moving troops quickly to the east bank of the canal in the Central Sector was the floating bridge at Ismailia; the ferries were too slow as well as too limited in carrying capacity for the purpose. The mounted troops at General Wilson's disposition on the morning of this date were the Imperial Service Cavalry Brigade and the eight companies of the Bikanir Camel Corps. Some of the squadrons and companies of these forces were distributed among the three sectors of the defense, the remainder being in the neighborhood of the bridge. The Yeomanry stationed in Cairo was ordered to proceed by train to Ismailia, but they failed to arrive until evening. Even so, the cavalry consisted of only 16 squadrons, most of which lacked sufficient training. Water convoys were nonexistent, and water could be transported only on pack animals. It will therefore be readily seen that the forces which might have been employed in any counter-offensive or pursuit were unsuitable in both composition and equipment for an advance beyond the immediate vicinity of the canal.

What was still more important, however, was the danger of a reverse, which would have had an ill and far-reaching effect. Consequently, unless an exceptional opportunity presented itself, it was decided to make only local counter-attacks and not to carry the pursuit beyond 10 miles. The strength of the enemy was not definitely known, nor were his intentions. For example, when, on February 6, orders were issued for a reconnaissance by a force of all arms from Ferry Post, these orders were cancelled when reports were received from agents that the enemy expected considerable reinforcements. The truth of the matter was, however, that the Turks were in full retreat, but not until the middle of the month did General Wilson become assured that the Turkish troops, which he had reason to believe were in reserve at Beersheba, had not left that town for the canal front. The breakdown of the hard-worked French seaplanes was the reason why the intelligence service was unable to discover that these reserves were still on the other side of the frontier; those planes which attempted to reconnoiter Beersheba failed in their mission on account of mechanical troubles.

Traffic on the canal ceased for a few nights and during the daylight hours of February 3, otherwise the attack failed to disrupt communications via it. The British casualties were not heavy, the total being 163, of which ten were in the Royal Navy, most of these on the HARDINGE. The enemy loss was difficult to establish exactly, but British headquarters estimated them as more than 2,000. Between January 30 and February 9 the British took 716 prisoners, and between January 28 and February 4 they buried 238 Turkish dead; besides these a number of Turks were drowned in the canal.

Considering the strength of the enemy and the hazardous nature of the enterprise, these losses were very low. But the Turkish defeat was a blow to his prestige, although its damaging effect was somewhat lessened by the fact that the troops had been able to disengage themselves and return without further molestation to their base. The defeat did, however, have considerable good effect in Egypt, and Turkey descended the scale in the estimation of her admirers, while British sympathizers, including the Egyptian Government, were relieved of fears regarding their situation and became confirmed in the attitude they had adopted towards the British. (*In the next issue the author will discuss the second phase of the defense of the Suez Canal and present certain analogies and problems connected with the United States' military requirements at the Panama Canal.*)

International

TANK CORPS OF THE GERMAN ARMY, NUREMBERG, SEPTEMBER, 1935.

Architectural Air Protection

How Europe Provides Gas Shelters for Civilians

By Hans Schoszberger*

THE technique of arms has had an influence on architecture for centuries past. Every modification of warfare and every new weapon have always resulted also in architectural modification. The medieval town is a faithful model of the war technique of the times just as the detail of architecture in the towns of ancient Rome allow us to trace the nature of the war machines which were used to assail her walls.

The World War and the subsequent development of the technique of arms have produced a really new weapon—the airplane. It is likely to influence architecture so effectively that we cannot yet foresee the consequences. As a result of "war in the air," it will not be possible any longer to confine hostilities to the front-line. It will be necessary to secure the country itself against the incendiary bombs and gas-bombs of the raiding pilots. Just as the invention of gunpowder and the big guns caused the dismantling of the old ramparts, it is obvious that the flying-machine will necessarily also affect town-planning and architecture.

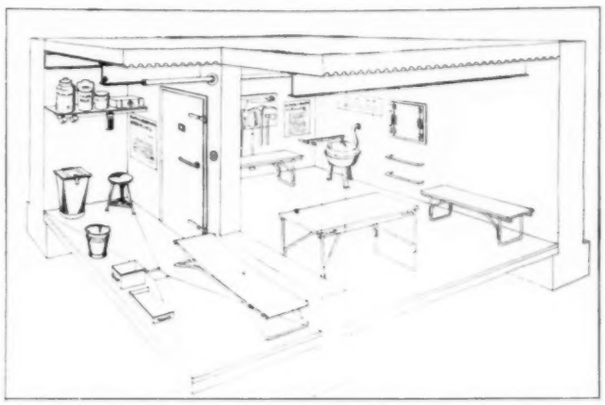


FIG. 1. GAS SHELTER IN A DWELLING HOUSE.

All furnishings are of steel. Note drain at left; gas-proof door leading to shelter; emergency outlet (at right); apparatus for fresh water supply (at left). Roof covering is made of corrugated iron.

Technical Air Protection is based on the theory which deals with architectural measures adopted against air raids. Although quite a new branch of development (it is three years old) there has been such rapid progress of late, that further advancement is at hand. Most European countries have already promulgated laws concerning air protection, the building industries are manufacturing diverse constructive parts for use in air protection, and the number of shelters built as well as the number of new houses erected along the principles of these considerations is considerable.

Would there be any sense in all these developments if there were to be no wars—a hope in which we technicians of air protection devoutly share? An exhaustive inquiry into this problem results in the astonishing fact that a great part of the measures taken in regard of air protection continue to be useful even if no air raids are ever undertaken against towns. Every measure of protection taken against incendiary bombs is at the same time a protection against the outbreak of fire. Not only is a wider distribution of areas and buildings required by air protection but likewise in respect of hygiene and social considerations. The shelter is the only institution exclusively devoted to air protection. Well-organized air protection, however, will certainly be very helpful to scare away the assailant and it will assist to prevent attacks against defenseless townspeople.

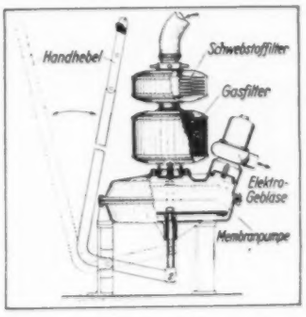


FIG. 2. SHELTER VENTILATOR.

For drawing purified air; electrical or manual operation.

In contradistinction to the countries of Europe, the United States is able to ignore architectural air protection, due to its comparatively favorable situation. So it is necessary to make the following statement before going into technical details: *All the construction and protective devices as described here are not theoretical proposals but facts; they have already been carried out to a certain extent and prescribed by law for new buildings.*

The province of architectural air protection consists of three phases: (a) The building of shelters; (b) measures of air protection in constructing buildings; (c) the relations existing between town planning and air protection.

THE shelter has to fulfill the task of protecting the people against the various effects of air bombing in the course of an air raid. Nearly all countries in Europe have published decrees regarding the building of shelters. The greatest progress seems to have been achieved by France and Germany. But Italy, Poland, Czechoslovakia and Russia have issued regulations governing the building of shelters which show clearly that these countries, too, are far advanced in this field.

In general the plan has been abandoned to build shelters for protecting the townspeople against *direct hits* of explosive bombs. This kind of protection would be much too expensive and, since bombs striking directly into dwelling houses will be a mere chance, this protection can be dispensed with. The shelter of the dwelling-house offers safety against gas, incendiary bombs, crashes, bomb splinters and the violent concussions produced by explosive bombs. Shelters of a military character, and those in important factories, however, must be built so as to protect against direct hits of bombs up to a certain weight. In most countries of Europe the raising of funds incurred for the building of shelters has been so arranged that the owners of houses who build shelters

*Author: "Architectural Air Protection." By Dr. Ing. Hans Schoszberger. Bouweltverlag, Berlin, S. W. 68, Charlottenstr. 6, Germany.

for the occupants, either are granted immediate financial help or a considerable reduction in taxes. Public shelters accessible from the street and intended for occupancy by the people on squares and in streets who are being menaced by an air raid are built by the state.

Shelters must be provided for in planning new houses. It is always cheaper to take the necessities of air protection into consideration when planning the house than to do so when the house is completed. In ordinary houses and office buildings it is best to have the shelter in the cellar (Fig. 1). Only in special cases will they be located above ground.

Fig. 3. Gas Shelter Installed in Existing Cellar.

The ground-plan of the shelter should be in the shape of a longish rectangle with two exits as far apart as possible (Fig. 6). Should one exit be barred by ruins it must be possible to utilize the other. The entrance to the shelter is made through a gas sluice providing room for three people and the instruments necessary for an elimination of poisonous gases. In ordinary buildings and with all simple shelters, the second exit is replaced by an emergency outlet. A cellar window will have to be so arranged as to enable getting out by way of crampons after dismantling the rails.

The size of the shelter depends on the number of people normally seeking refuge multiplied by the amount of air necessary per capita. This amount of air differs according to the kind of ventilation chosen. Should an artificial airing be provided for by way of filtration, 1 cubic meter will be sufficient per person. In the absence of artificial ventilation 3 cubic meters per person will be necessary. This quantity of air is sufficient for a stay of three to four hours. Built-in filters will have to produce a quantity of air of at least 50 liters per minute per capita. In case of artificial ventilation, the air filled with gases is extracted from outside by a tube, purified in the filter (similar to the process in the gas mask) and then pressed back into the shelter as clear air (Fig. 2). Airing contrivances are now manufactured in Italy, France, and Germany. The appliances used for air protection are far more effective than those used in dugouts during the Great War. The apparatus is mostly electrically operated but manual operation must be provided for as well, as a destruction or an interruption of current from the power station has to be taken into account. About 30 to 50 liters of air are produced per person and minute. Such a ventilating system is of great advantage as it produces an air pressure which prevents any admission whatever of gas. The shelter is to be as small as possible; capacity of 20 persons is desirable, 50 persons the limit. Large rooms should be subdivided by massive intermediate walls of 25-cm. thickness which are firmly connected with the outer walls.

The ceiling of the shelter must be able to withstand any ruins that fall upon it, but it is *not* intended to act as a means of protection against direct hits of bombs. The ceiling must not crack under the weight of the ruins and it must withstand splinters crashing through. In case of new buildings there should be no provisory timbering and the ceiling of the shelter must obtain the necessary strength from the outset. Ceilings of iron-concrete or steel are preferable.

The walls of the shelter must withstand violent gusts of air and the impact of the ruins and splinters caused by bombs. In new buildings shelters are so constructed that their outer walls are not visible above the ground or only slightly so. The approximate measure of the thickness of walls will be: 38-cm. for brickwork, or 25-cm. for iron-concrete. It is advisable to stay the walls and the ceiling. Shelters having ceiling, walls and floor all in one square cube, are especially recommended. Solid brickwork, well plastered on either side, and walls of concrete protect thoroughly against the invasion of poisonous substances. It is unnecessary to give the interior walls of the shelter an oil paint coating or a coating to flush the joints.

There should be a minimum of openings in the wall of the shelter; it will be best to have only the two doors of the gas sluice and the emergency exit. The small windows of the shelter should be closed, on the outside, by means of a steel diaphragm. A special protective diaphragm is for warding off debris and splinters. The windows must admit of comparatively easy operation, as it must be possible to refresh the air in the shelter quickly and vigorously. The doors, which are of steel, are rigidly held against the packing by means of a special lever locking device. In most European countries there has sprung up, within the last two years, quite a new industry for the manufacture of gas-proof shelter doors and shelter windows made of steel. A good many products are on the market which differ only in the arrange-

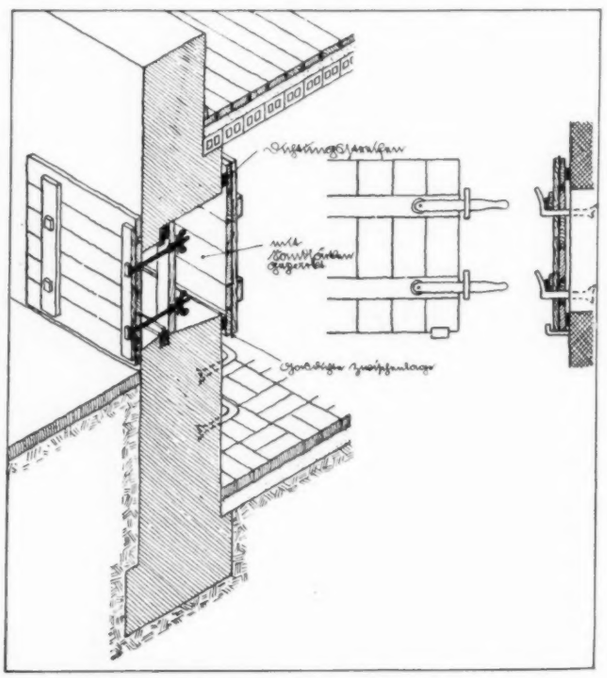


Fig. 4. Shelter Window Protection.

ment of locks and packing rubber. Other openings such as fireplaces must be closed tight in a similar way. The shelter should be free from any piping. If this is impossible, it will be necessary to pack the pipes in the places where they pass through the wall of the shelter, as the violent shocks to which the pipes are exposed will cause them to leak. In this case a special packing and plaster are used similar to those used for tightening up wall-cracks.

An emergency lavatory for about 20 persons must be a part of a shelter. Emergency lighting (electric pocket-lamps) and a water-tank must be provided. No heating is necessary. A shelf with tools, a medicine-chest, instruments for quenching fires and deodorizing stuffs are required. Directions indicating the way to the shelter and an adequate inscription of the walls are indispensable.

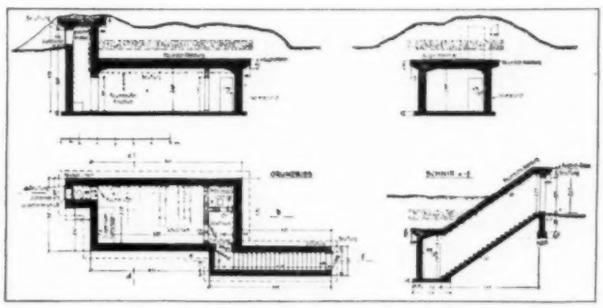


FIG. 5. IRON-CONCRETE SHELTER FOR PROTECTION OF FACTORY WORKERS.

In some cases it will be necessary to provide for shelters that are different from those in dwelling-houses as just described. Shelters built in factories require a particular treatment. In Fig. 5 is shown a detached shelter made of iron concrete which is mainly used in factories. Above the ceiling there is a cover of ballast for bringing about an explosion of bombs before reaching the ceiling of the shelter so that the gas pressure following the explosion will not be directed immediately against the ceiling. The walls and the ceiling are provided with a special steel coating.

In Fig 6 is shown the ground plan and section of a shelter made of steel pile planking. The planks are rammed into the ground, and then the ground between is dug up and a concrete foundation is laid. The walls are provided with a horizontal planking filled with concrete. Fig. 7 and 8 show the interior of such shelters formed and a view of a gas sluice.

A shelter in course of construction formed of steel links is shown in Fig. 9, while Fig. 10 shows the interior of such a shelter. After digging a deep ditch, a foundation of concrete is laid. Steel links are put up and connected, gas-proof, with each other. Semicircular and pointed links are used. After mounting the shelter, the ditch is closed.

A shelter of iron concrete, as used in France, is shown in Fig. 11. The concrete cover is overlaid with quarry stones which are kept in a slanting position by a wooden frame. The slope of the external wall is best covered with a layer of iron rails or steel supports.

Single workmen of a factory are not permitted to leave their places during an air raid. They must be ready to work important machines. For this purpose small protecting cells of concrete or steel are produced for protecting the workmen against splinters, ruins and gas. Fig. 12 shows a cell of this kind of French origin. In the event of an air raid, the workmen seek refuge in this cell and are able to watch the working of the machine from peep-holes.

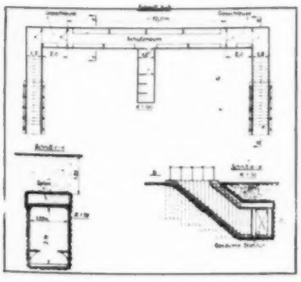


FIG. 6. TWO-ENTRANCE SHELTER.

Shelters formed of cubic pile planking are shown in Figs. 13 and 14. Cubic pile planking of steel is rammed into the ground. Then the earth is dug out of the interior of the piles and concrete is cast in. The wall is completed in a similar way. These shelters afford a certain amount of safety against direct hits of explosive bombs.

THE principles pursued in building shelters in new houses are applied also with respect to old buildings. The more these principles can be carried out, the greater will be the effect of the shelter.

The position of the shelter must be determined in accordance with the surroundings. It will be best to build the shelter in cellars. If not feasible, rooms should be selected on the ground-floor without outside-walls, but provided with powerful brickwork and few doors. In extreme cases of emergency, the corridors of ground-floor flats may be transformed into shelters.

The ceiling of the cellar, in most cases, cannot support the load of ruins lying on it. Therefore it will have to be reinforced. The construction of the timbering is shown in Fig. 3. Apart from the timbering a steel support of the ceiling is frequently used of late. Also a new ceiling of concrete may be added to strengthen the old ceiling.

The walls of the shelter have to be at least 1½ stone thick. An additional strengthening of weaker walls by erecting other walls behind, or reinforcing them by concrete (Fig. 10) may be advisable in some cases. Loose walls, or those showing cracks, have to be repaired. A protective coating of the inner wall of the shelter is unnecessary.

The openings of the shelter should be closed tightly to guard against ruins, and poisonous chemical stuffs. Apart from steel doors and steel windows manufactured for shelters, there are also provisory constructions built of wood in old buildings. Fig. 4 shows the closing up of a cellar window by means of two wooden blinds. On the outside a board secured by earth or stones guards from ruins and splinters. Inside a blind fitted with strips of felt, or the like, is for warding off poisonous chemicals. Both the boards are strongly pressed against the walls by iron bolts and winged nuts.

IT is incumbent with architectural air protection not only to guard the people from bombs, but also to protect the buildings. The adoption of a certain method of construction and an adequate selection of building materials will help to sensibly reduce the damage inevitably caused by bombs. It cannot be expected that all buildings of a town can be secured against air bombs by the building in of concrete ceilings, steel roofs, etc.

FIG. 7. INTERIOR OF SHELTER SHOWN IN FIG. 6.

But houses of special importance such as factories, hangars, military buildings, etc., may be so secured by architectural precautions as to keep the damage small even in the event of direct hits by heavy bombs, and to insure rapid recovery after the raid.

In the province of new buildings there are but few practical

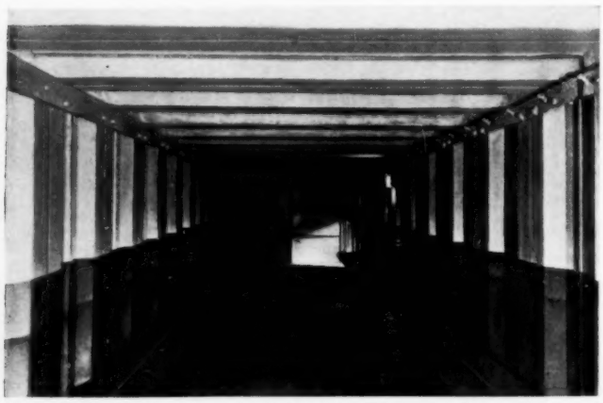


Fig. 8. Interior of Typical Factory Shelter.

directions as yet. The architect should closely observe the conditions and take steps accordingly. No binding prescriptions have existed hitherto. In respect of all new buildings the principles of air protection should be taken into consideration from the outset. The effects of bombing require no new or dearer constructions whatever (iron-clad covers, etc.). A careful examination has proved that the degree of safety of a building against air raids is dependent on the up-to-date selection and application of building materials and the mode of construction.

It has been suggested the effect of bombing may be reduced by building strong ceilings of concrete. This proposal is to be rejected! Such armored ceilings would be very expensive and applicable only to buildings of special importance

Fig. 9. Shelter Made of Steel Links Sunk into Ground or Hillside.

situated in the danger zone. These buildings, however, will be attacked by special bombs of the coarsest caliber, so that the ceilings will be destroyed without fail. Under these circumstances the armored ceiling will endanger the whole building, as it contracts the gas pressure of the exploding bomb, while the ruins of the ceiling hurled in all directions, will be very dangerous. The proposal to interrupt the fall of the bomb through several ceilings cannot be accepted. Trials have determined that explosive bombs of 100 kg. in weight will break through the massive ceilings of usual thickness. Stronger ceilings would merely result in the construction of heavier bombs. This would bring about the throwing off of a smaller quantity of bombs, but on the other hand, such armored ceilings, in the event of bombs bursting in the interior of the building, would prove very dangerous to the whole building. Elastic roofs and metal nets for catching up the projectiles are absurd suggestions.

A building will be least damaged in the event of an exploding bomb if constructed as follows: A framework of very

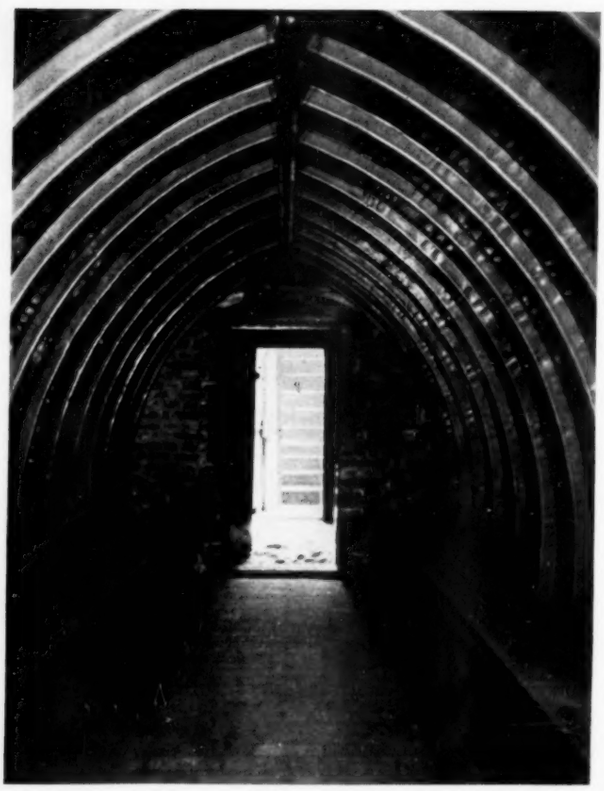


Fig. 10. Interior of Shelter Shown in Fig. 9.

strong construction, offering but a small surface of attack, is filled up with a light and elastic material. As the gas pressure and the violent gush of air produced by the explosion of the bomb always take the course of least resistance, the filling will give way to the explosion so that the framework remains intact. Accidents caused by explosions have shown that framework construction of this description is only slightly damaged while solid buildings are completely reduced to ruins (Fig. 15). Frameworks of steel and iron concrete are adequate to requirements of air protection. There should be no rigid connection between the filling and the framework. Industrial buildings constructed along these lines, as well as public buildings of importance, and all buildings

having a wide area, will be damaged only in some parts even in the event of the bursting of the heaviest bombs.

For buildings of smaller size, small dwelling-houses and business premises it is not advisable to adopt the "safety-valve" system as the framework construction is called in technical terminology of air protection. The security of these small buildings is confined to the long distance effects of bombs. In these cases compact self-contained buildings giving safety against bomb-splinters and ruins are desirable. Solid construction of thick brickwork or iron concrete is desirable as far as small buildings are concerned.

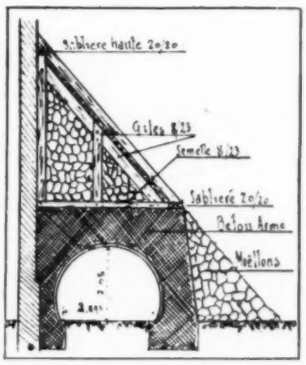


FIG. 11. FRENCH TYPE SHELTER OF IRON, CONCRETE AND STONE.

All edifices must be provided with a firm foundation to provide against the shocks produced by the explosive bomb. Light building materials causing no further damage when hurled away should be used. No exact details are available as to the forces of the assailing power and the choice of the building materials resulting therefrom. Nor is there any special mode of construction which, in all respects, is based on a consideration for air protection. Some research work is, however, being done in this respect.

THE incendiary bomb is likely to be of low weight because a small composition will do to set an object on fire, if unprotected. The incendiary bomb, according to foreign publications, will take effect in the attic and not pierce the top ceiling. Its weight, therefore, will be low. Accordingly it will be possible to ward off these bombs by way of special protective roofs.

Force of impact can be neutralized by means of the roof cover or the uppermost ceiling. A concrete platform of 10 cm. thickness will probably resist the impact caused by smaller bombs. Steel roofs have been recommended.

As to dwelling houses it is generally impossible to make the roof covers of concrete or steel. It is generally thought sufficient to ward off bombs by the top ceiling. This ceiling should therefore be of a uniform structure and not consist of single stones, as a dropping bomb may easily knock them out of the assemblage. The ceilings must be fire-proof and water-proof. The solid top ceiling should show a slight incline for drainage and it should protrude beyond the outer walls. It is covered with a layer of very hard, brittle plates, or a quenching layer. A sand cover mixed with plaster will be sufficient.

Since the incendiary bomb takes effect in the attic, all its parts susceptible to catching fire must be secured against such an emergency. In many European countries the first step taken by air protection was the so-called "clearing of lumber-rooms and attics." All lumber is removed from the attic and a number of house-occupants—the local house fire-guard—are trained to fight fires, as the municipal fire-guard is quite unable to extinguish all fires in case of emergency.

WAR chemicals, even in strongest concentration, cannot affect building materials to such an extent that it counts much from the point of view of an architect. As to overground buildings in general it is unnecessary to take gas danger into consideration. It is erroneous to assume that certain chemical stuffs can so affect steel and iron as to sensibly impair the solid features of these materials.

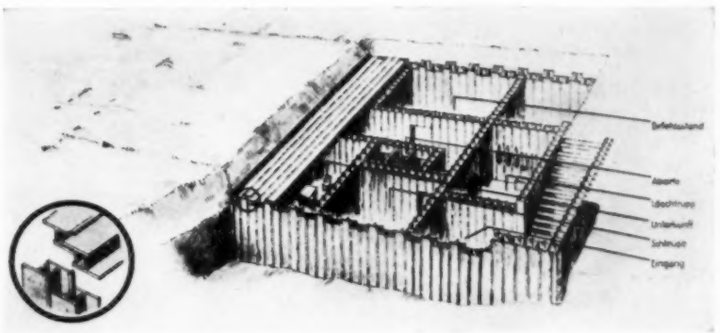


FIG. 13. SHELTER MADE OF CUBIC PILE PLANKING SECURE AGAINST DIRECT HITS, FOR USE AS HEADQUARTERS, TELEPHONE EXCHANGE, ETC.

In some cases, e.g., in factories, buildings on airdromes, etc., the *elimination of poisonous stuffs* must be taken into consideration when disposing of the buildings on the plan and selecting the building materials. After an air raid the buildings and streets must be freed from the adhering chemical substances by applying water and chloride of lime. As mustard gas penetrates deeply into porous building materials and can be removed only with difficulty, architectural air protection makes a selection among the various building materials according as they allow mustard gas to penetrate, or not. Steel roofs are preferred to roofs of asbestos and the outer walls of the houses are given an oil paint coating. These requirements are, however, confined to houses of importance that are presumably the aim of frequent gas attacks.

It is a very difficult thing to adapt old buildings to the requirements of air protection. In most cases it is absolutely useless to provide protection against direct hits of explosive bombs, whereas it is possible to secure them against incendiary bombs and chemical stuffs.

Old buildings can be guarded against the effects of explosive bombs only with great difficulty and at high cost. The host of directions issued in this respect have not yet revealed one single working proposal as to the protection of old buildings against explosive bombs. Some particular buildings of

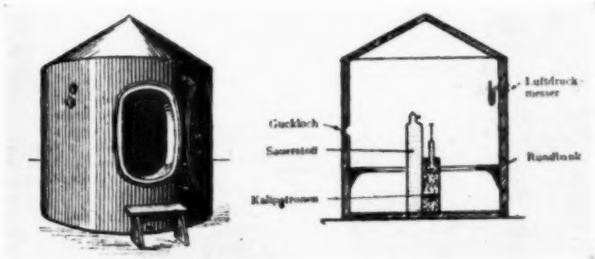


FIG. 12. THE FRENCH "ABRI MARCILLE" CONCRETE CABINET SHELTER. AIR REGENERATION IS BY POTASH CARTRIDGES AND OXYGEN FLASKS.

importance which justify high costs, will admit of securing the structure against explosive bombs by ultimately adding some framework containing ceilings and a roof. The old wall may then give way to the gas pressure, in some places, without causing a complete breakdown of the building. By adding to the surface of windows and the replacement of heavy ceilings by light roof covers, some vague protection may be afforded. Works of art and monuments are protected by timber-walling, pile-planking, sandbags, etc., against the effect of explosive bombs.

Fig. 14. Pile Planking Shelter in Building with Concrete Filler Between Planks and Building Wall.

It is either impossible, or very expensive, to make the roof cover of old buildings resist the impact of incendiary bombs. It has been thought sufficient, therefore, to ward off the fire-bomb by means of the top-ceiling. This may be done by reinforcing the original ceiling through a new sturdy massive ceiling which is particularly recommended where the old ceiling is formed of wooden beams. Or (not so good) a layer of loam, sand, and clinkers, and the like, is put on the original ceiling. Smaller incendiary bombs may stick fast in this layer so that the inflaming properties of the bomb are thereby diminished. The original ceiling must be made water-proof.

The intermediate walls formed of wooden planking in the attic will have to be replaced by a wire-netting. All superfluous and easily ignitible lumber must be removed. The whole loft must be tidied up in order to enable the house fire-guard to reach every place without difficulty and to destroy the fire-bombs as quickly and efficiently as possible.

The technique of arms has had a decisive influence on the planning of towns for centuries. A new invention in the field of war technique, such as gunpowder, has resulted in a remarkable change of the feature of towns. Similar to the influence which guns have had on the demolition of old walls and towers has been also the influence of bombing planes on town planning.

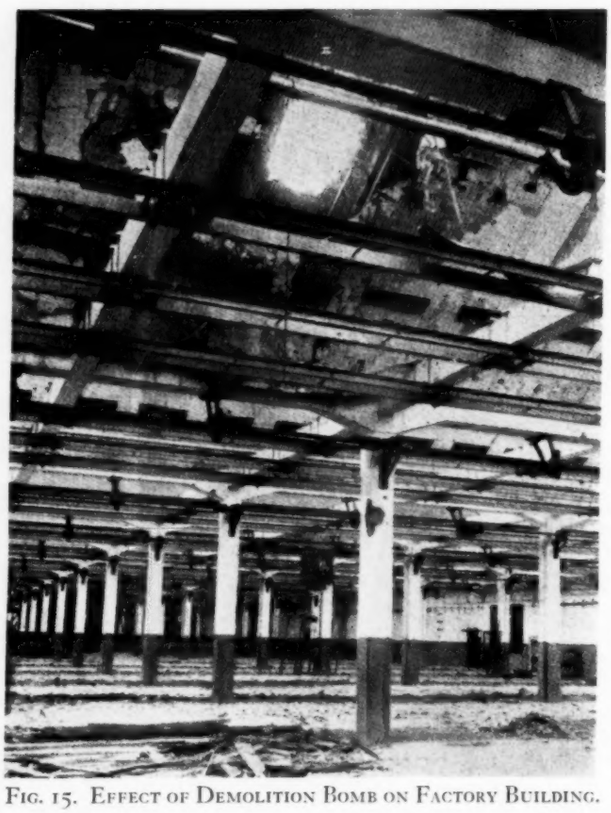


Fig. 15. Effect of Demolition Bomb on Factory Building.

THE relations existing between land planning and air protection are the most important questions arising in this field. While the aforementioned measures form but a partial means of protection, the whole problem of air protection may find a complete solution, in the distant future, with the help of a scheme of land planning achieved on a large scale. Air protection requires a wider distribution of houses in towns. In their present form, towns can never find full protection against air raids. The densely peopled quarters of big cities, the tenement-houses offer a great resistance to an efficient plan of air protection. Towns like Paris, Berlin, or London, with their densely packed structures and narrow lanes can never find full protection against air-raids even when all the aforementioned measures are carefully observed. It is, however, possible nowadays to afford full protection, against air raids, to a widely distributed group of houses. The same applies to factories located in the open country. Extensive greens, broad streets, gardens and stretches of water are the best possible means of protection. They are even better than the strongest cover of concrete or armor plate.

How can air protection be taken into account when planning new settlements?

The wider the plan the better. Detached cottages are preferable to rows of houses. Flat-roofed houses are to be preferred to medium-high structures (3 to 6 floors). Quaint shapes of squares and street ducts, as e.g. circular, or oval forms, should be avoided, as they facilitate the aggressor to hit the mark.

It is the object of air protection to bring about an intimate connection between town and country. All attempts in this direction, be they the separation of factories from towns, the transfer of townspeople into the flat country, or the rebuilding of slums, are to be welcomed. The erection of big office-buildings in the center of the cities, the enlargement of factories lying on the outskirts of towns, etc., are measures hostile to the aims of air protection. Whole cities have already been built under the aspect of air protection. Industries of importance have been established in Soviet Russia as so-called "band cities." The factories have been entirely cut off from the dwelling area and their oblong shape facilitates defense by means of observation planes and anti-aircraft guns. The ideal town for air protection is a group of houses arranged at wider intervals, in which industrial and dwelling areas are entirely cut off from each other, since either of them requires a different mode of air defense and also a different architectural structure in conformity with the principles of architectural air protection. It is the aim of air protection to create an extensive and detached grouping of houses, in a word, a village showing the features of a town—a new mode of town planning that implies the detached grouping of the village, and the means of communication typical of town life.

Weather and Warfare

The Military Uses of Meteorological Data

By Clarence F. Wells*

WEATHER has exerted a tremendous influence on the outcome of wars and campaigns from the early dawn of history to the present time. Valor, man-power and machines have all fallen before the raging storms and shifting winds. The weather has been one factor in warfare that man has not been able to control. It is said that if we cannot control the weather, the next best thing is to know how to take advantage of weather conditions. The Israelites on their way into the Promised Land were quick to take advantage of a temporary shoaling of the Red Sea while a strong east wind was blowing and if Pharaoh had only had a competent force of weather forecasters and modern meteorological instruments, he would have been warned of a sudden change in the barometric pressure and a shift in wind direction.

In 1194 B. C., Ulysses with an army of one hundred thousand men landed on the Trojan shores on his way to the siege of Troy. Three thousand years later we find another army trying to land on these same shores but with less success.

During the month of January, 1915, the British and French naval authorities came to a decision to attempt a naval attack upon the Dardanelles. It was decided to lose no time as the essential factor must be surprise. The first bombardment was effective as the Turks were taken unawares. But, just as success was within reach, the weather changed. Southwest gales forced the ships to put out to sea and an opportunity passed never to return. A second bombardment followed but the Turks with their floating mines and submarines were more than an even match for the biggest battleships. From the blistering heat of the month of August to the howling blizzards of early November, life was made miserable for both man and beast. During November a blizzard raged for three days and when it was over the entire army was incapacitated and evacuation was inevitable. On the night of January the 8th the last foothold was relinquished and none too soon, for on the following morning a southeast gale swept the coast and this gallant army was spared a final and overwhelming catastrophe. The scorching winds of August and the howling blizzards of November once more showed their superiority over the supreme efforts of man.

THE antiquity of meteorology, many of our proverbs and much of our weather lore show that meteorological observations were among the first acts of an intelligent race. The Babylonians were versed in the science of meteorology and one of their clay tablets dating from about 4000 B. C. contains the following weather proverb: "When a ring surrounds the sun, then will rain fall." Aristotle wrote the first treatise on meteorology about 350 B. C. Their observations were crude, practically all were made without the help of instruments, and were often inaccurate and much influenced by superstition.

Our modern science of meteorology may be defined as the physics of the atmosphere. It treats of the condition of the atmosphere, its changes and the cause of these changes. The annual change from summer to winter and back again from winter to summer, with all its attendant phenomena in vegetation, the daily change from the heat of the day to the cool of the night, the falling of rain and snow, the coming of the thunder showers and all such things have profoundly occupied the mind of man from remote ages.

It was not until about 1600 A. D. that observations began to be taken with any degree of accuracy due to the invention of instruments for use in taking such observations. Galileo invented the thermometer in 1590 and Torricelli the barometer in 1643. About 1850 various governments began to establish weather bureaus and great advances began to be made in the science of meteorology. It may be said that this was the beginning of the application of meteorological data to the use of human needs. The utility of meteorological information may be shown in the financial saving caused by timely forecasting of those weather conditions which do damage to commerce, agriculture, products in transit, and business of many sorts. There is probably no subject which so fully occupies our attention and is of so much importance to us as the weather, and yet there is probably no subject about which the ordinary person knows less and where ignorance is more universal. The weather enters into every aspect of human life. Our plans are daily made and unmade on account of the weather and in fact our very moods depend upon the weather. The student of criminology tells us that certain crimes are more prevalent at one season of the year than at another and that the particular type of weather influences the crime wave. For instance, it has been found that theft is more prevalent in winter than in summer since unemployment and cold weather make both food and clothing more imperative. The physician tells us that certain diseases show a well-marked seasonal variation and are more prevalent with one kind of weather than another.

THE military uses of meteorological data are just as numerous. The Air Service is especially dependent upon a knowledge of atmospheric conditions for it is the atmosphere which must support its aircraft and unfavorable conditions may cause the loss of lives and ships. During the latter part of 1916 and the early months of 1917, the Germans had been exerting a mighty effort to build up a fleet of Zeppelins for the purpose of bombing the English coastal towns and the city of London in particular. This would not be the first attempt to bomb the British capital but so far no such fleet had ever been gathered together. However, by October 13th ships were ready and everything seemed to be set for the raid —everything except the weather. For many months the meteorologists and weather forecasters had been making meteorological observations and gathering weather data from various points in northwestern Europe. Hopes were running high. If London could be successfully bombed, the Germans were certain that the British people would clamor for peace. October 17th dawned with fair weather and after checking the latest reports the weather forecasters gave the word to start. Weather conditions favored a high barometric pressure area over northwestern Europe and with southwest winds. Every-

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thing would have gone well if the weather had remained settled. Notwithstanding the cleverness of the German forecasters, they did not have full information from the west. During the day a low barometric pressure area had developed out over the Atlantic, west of the British Isles. The warm southwest winds were quickly routed by cold north or northwest winds. By midnight the fleet had succeeded in reaching the British Isles and one ship passed directly over the city of London. From midnight until early morning the fleet was carried southeast. When dawn finally broke the raiders supposed that they were directly east of London, when in fact they were southeast of London and were then passing over the plains of Flanders and the French battle lines. A heavy, dense surface fog prevented recognition of the territory below. As they dropped in altitude in order to get their bearings, the noise of the engines was heard and their presence detected by the enemy. French airmen were quick to take advantage of the weather. Some of the ships were shot down over the battle lines, one escaped westward and fell into the sea off the western coast of France, and the flagship fell into the hands of the enemy. Once more Britain was saved from an invincible armada by the weather and Germany lost the supremacy of the air.

THE Artillery depends upon the atmosphere for its projectiles to reach the target and any factor which may enter to influence the stability of the atmosphere may materially influence the outcome of the mission. Shifting winds, poor visibility due to mists, fogs, and smoke all play their part in artillery firing. Let us go back to the early afternoon of May 31, 1916, and we find Admiral Beatty with the battle cruisers of the British fleet. He has just received word from the scout ship that the German High Sea Fleet is out in full force. The afternoon came in with a smooth sea, a light wind, and a clear, though somewhat hazy atmosphere. The smoke of the German ships was made out at a distance of close to twenty miles. But these atmospheric conditions did not continue long. Little wisps of fog began to gather here and there, drifting about, rising from time to time and then settling down and gathering in clouds that at times cut off the view even close at hand. At four o'clock firing began across a ten-mile gap. The British were handicapped by poor visibility, haze and smoke which prevented good marksmanship. At half-past six the British battleships arrived and soon engaged the enemy. At seven o'clock the visibility had improved somewhat but now the German destroyers began throwing out smoke screens. By eight o'clock the German fleet had disappeared in the fog and smoke and the battle of Jutland was ended. Shifting winds and poor visibility due to mists, fog and smoke played their part that day.

Meteorological conditions vitally affect the communications maintained by the Signal Corps and during military operations the whole army depends upon the Signal Corps for large-scale observations and meteorological data. On August 29, 1776, the American Army was badly defeated at the battle of Long Island and found the British fleet in the East River, thus cutting off retreat. After a hasty conference it was finally decided that under cover of darkness the army should be taken over to New York. There never was a movement more skilfully ordered, conducted with more consummate address, or more highly favored by the aid of Providence. The wind in one place seemed to change according to their wants, and in another, a fog veiled them from hostile view. So by the aid of Providence and a dense white fog the army slipped across to New York and the independence of America was saved once more.

Twenty years after the battle of Long Island, Napoleon found it necessary to hurry back to France from his Egyptian campaign. The entire voyage was one of constant peril, for the Mediterranean was traversed in all directions by the English ships of war. For twenty-one days, adverse winds blowing from west or northwest, continually drove the ships on the Syrian coast or back towards Alexandria. Finally by the aid of Providence and a dense white fog, he was able to escape Nelson's fleet and on the morning of October the 9th, he moored safely in the bay of Fréjus.

While the weather finally came to his rescue on this occasion, it later turned against him. By the middle of June, 1812, Napoleon had assembled his army of 450,000 men along the Niemen river in readiness for his Russian campaign. At once it was apparent that the weather was against him. On June 24th the passage of the Niemen began in torrid heat which lasted for many days. Within ten days his mounted troops had lost one-third of their strength. Men died of sunstroke in numbers and serious straggling began. Before five months had elapsed the Emperor was leading his straggling army in headlong flight. The torrid heat of early summer and the snowy blizzards of the month of December were a worthy foe of the master strategist and what had once been a mighty army had finally dwindled to a miserable band of ragged men.

THE importance of meteorology to the Chemical Warfare Service is certainly no less than to these other branches of the army for we depend largely upon the atmosphere to carry our chemical agents to the enemy and the effective use of these agents is entirely dependent upon proper meteorological conditions. Certain types of chemical operations can only be carried out when weather conditions are favorable, others are not always precluded by unfavorable conditions, but their effectiveness will be greatly reduced. Our protection against the use of chemical agents, also, depends largely uopn a knowledge of conditions favorable to the enemy's use of such agents and an accurate prediction of when and where we may expect to encounter them.

Early in 1915, the British Intelligence Service learned from German prisoners that a new form of warfare was soon to be launched by the Germans on the western front. This information was passed on to the British War Office but nothing was done and it is doubtful if the information was given the slightest consideration. The use of gas in warfare was not a new idea and at the same time both Germany and England had signed the Hague Pact.

The German army had not been idle during the month of April in the area around Bixchoate and Langemarck. Several thousand cylinders had been brought up into the front line trenches under cover of darkness. Everything had been in readiness for several days except the weather. The "prevailing westerlies" had been unusually steady that spring and gave the Germans no chance to try out their new experiment. However, during the early afternoon of April 22nd, the "prevailing westerlies" ceased to blow for a time, the steady southwest wind shifted to the northeast; if the Germans did not take advantage of this wind shift another opportunity might not come for weeks. Everything was ready and at about four o'clock in the afternoon, heavy, yellowish-green clouds of chlorine carried by the northeast wind rolled over the Allied trenches, laying waste the 8th Division of French

Territorials and a Canadian Division, producing 15,000 casualties and killing 8,000 men besides devastating the villages for many miles in the rear. The Germans had taken advantage of the wind for once but from this time on the prevailing winds were to be many times more favorable to the Allies.

The condition of the atmosphere at any particular time and place is determined by six meteorological or weather elements. They are temperature, pressure, wind, humidity, clouds, and precipitation. Military operations and especially chemical warfare operations are concerned with all of them. For example, the factors influencing the travel of gas or smoke on land are, in order of importance: 1) wind, its steadiness and velocity; 2) eddy currents due to proximity of woods, uneven terrain, etc.; 3) convection currents due to heat disturbances; 4) general air currents due to general meteorological conditions; 5) humidity. The effectiveness of all smokes is greatly increased by high humidity but on the other hand high humidity tends to destroy some of the toxic agents by hydrolysis. Cloudiness has a marked effect on the relative obscurance of smoke, and the persistency of most chemical agents is largely dependent upon temperature and wind velocity.

IT is estimated that the earth receives only a minute portion of the total radiant energy given off by the sun (one two-billionth), and yet the energy received in the course of a year would be sufficient to melt a layer of ice 241 feet thick covering the whole earth.

The ocean reflects about 40 per cent of the energy which falls upon it, transmitting the remainder to considerable depths and eventually absorbing all the energy transmitted. There is little change in temperature of the ocean between day and night, never amounting to more than one or two degrees.

Dry ground reflects but a small amount of the energy which falls upon it, transmits practically none, and absorbs nearly all. The rise in temperature of dry ground is very great. Since the ground is a good absorber of energy, it is also a good radiator and thus it cools rapidly at night. The ground during the day may become very warm and at night it cools off rapidly due to radiation. This diurnal oscillation in temperature, however, does not penetrate to a depth of more than two or three feet. The temperature changes between winter and summer do not penetrate to a depth of more than 30 or 40 feet; thus at this depth the highest temperature occurs in winter and the lowest in summer.

Pure air reflects but a minute quantity of the energy which falls upon it, absorbs as little and transmits practically all. As a result it changes temperature very little between day and night. Since the atmosphere contains more dust and water vapor near the earth's surface, the change in temperature between day and night increases with nearness to the earth's surface. The lowest daily temperature usually comes at about the time of sunrise and the highest temperature from 2:00 to 4:00 P. M. depending upon the season of the year. The average temperature for a day occurs at about 9:00 A. M. and 8:00 P. M. The rise during the morning and early afternoon is sharp, while the drop during the afternoon and night is long and slow. The time of year of the lowest temperature is during the last part of January and the time of the highest temperature is during the last part of July, in each case nearly 40 days after the time of least and greatest receipt of energy from the sun. The rise from February to July is slow and regular, and the fall from the last of July until the first of February is of the same nature.

At night the layer of air next to the ground grows cold and denser, and drains like water into the valleys and places of small depression. If the wind is unable to remove these pockets of cold air, a marked variation in temperature over a limited area will be found. However, as long as the wind velocity remains higher than three miles per hour these pockets of air will be removed and mixed with air at other points and no variation in temperature will be found. Since the question of variation in temperature depends upon the interplay between the drainage of colder air and the ability of the wind to remove these pockets of cold air, the variation will depend not only upon the elevation, but also upon the openness of the valleys, their direction, the roughness of the surface and the direction from which the wind comes.

Because of the tendency of surface air to cool and drain into valleys and depressions, such places in the vicinity of gassed areas will, on calm nights particularly, be likely to contain dangerous concentrations of toxic gases. Likewise it would not be advisable to launch a gas attack when the earth is giving off the maximum amount of heat, that is from 9:00 A. M. to 8:00 P. M. During this time the gas cloud would be carried aloft by the ascending air currents and its effectiveness would be lessened.

We are probably less conscious of atmospheric pressure and its change than of any of the other weather elements. It is true that great changes in atmospheric pressure do produce marked physiological effects, however we are absolutely unconscious of the ordinary changes in atmospheric pressure from day to day. In weather forecasting, however, the pressure is of greatest importance. We are concerned with it only in as much as it indicates coming weather and affects wind direction and velocity. There are daily, yearly and irregular variations in pressure. The amount of daily variation is small, usually never more than 0.2 inch. It is usually higher in summer than in winter. The irregular variations in pressure, particularly in the temperate zones, are far larger than any of the periodic variations.

AIR in motion near the earth's surface and nearly parallel to it, is called wind. The wind is named from the direction from which it comes; thus if air moves from north toward the south, it is spoken of as a north wind. The direction from which it comes is called "windward," and the direction toward which it goes is called "leeward." Whenever the wind direction changes steadily in a clockwise direction, as for example, from southeast through the south and southwest to west, it is said to "veer"; when the direction changes steadily in a counter-clockwise direction, as for example, from east through the northeast and north to northwest, it is said to "back."

The velocity of the wind and the force or pressure of the wind are so related that when one has been observed the other can at once be determined. It is the velocity which is of particular interest to us for the direction and velocity of wind are the two primary factors affecting the use of chemical agents in the field.

Before instruments came into use for the measurement of wind velocity, its value was determined by the estimation of its effects. Even today, when in the field, it is often desirable to know whether we have a 4-mile wind or a 25-mile one. This may be done by estimating its effects as for example: 0 miles per hour—No perceptible movement of anything.

0-4 miles per hour—Just moves the leaves on the trees without swaying the branches.

4-12 miles per hour—Moves branches on the trees, and blows up dry leaves from the ground.

12-22 miles per hour—Sways the branches on the trees, and blows up dust.

22-32 miles per hour—Sways whole trees, raises clouds of dust and hinders walking.

32-72 miles per hour—Breaks small branches from the trees and hinders walking decidedly.

72-on miles per hour—Causes more or less complete destruction of everything in its path.

Immediate surroundings affect both direction and velocity of wind. The four things which may be considered in this respect are: valleys, buildings, nature of the surface and altitude. Valleys have a tendency to cause the wind to blow along their length. Buildings increase wind velocity near them and cause the wind to be gusty, as is illustrated by drifting of snow around your garage in winter. The velocity of the wind is very much reduced near the earth's surface. This is brought about by friction, intermingling of air masses and the formation of eddies. This can be noted in observing the travel of smoke clouds. Wind velocity increases markedly with altitude, and the increase is very rapid in the first hundred or two hundred feet. All of these factors should be considered in the use of chemical agents in warfare.

The time of day has a marked effect on wind velocity. The higher wind velocities usually occur during the day and the lower velocities at night The maximum usually occurs between noon and four o'clock in the afternoon, and the minimum in the early morning just before sunrise. The reason for this daily variation is to be found in convection. During the day the layers of air near the ground become heated and as they rise, due to convection, the colder air must come down to take the place of the rising air and bring with it the higher wind velocities of the upper atmosphere. A study of the gas attacks in the World War will show that a large majority of them took place in the early morning.

THOSE winds which would occur on any planet heated at the equator and turning eastward on its axis, are called planetary winds. Such a planet would develop a belt of low pressure at the equator, belts of high pressure in the tropical regions, and caps of low pressure at the poles. One would thus expect calms at the equator and in the tropical regions, and wind blowing outward from the belts of high pressure, turning to the right in the northern hemisphere and to the left in the southern. This is exactly what we find from observations made in different parts of the earth. The equatorial belt of calms is called the "doldrums." The doldrums are thus characterized by light baffling breezes, frequent calms, overcast sky and heavy rains, often in the form of thunder storms and squalls.

The tropical belts of calms are called the "horse latitudes." They derive their name from the fact that in early days sailing vessels carrying horses to the West Indies often became becalmed and had to throw the horses overboard for lack of water. The wind is here characterized by being light and variable and with small velocity. Calms are frequent; the sky is usually clear.

The winds blowing from the "horse latitudes," belts of high pressure toward the equator are called "trade winds." In the northern hemisphere they are the northeast "trades" and in the southern hemisphere they are the southeast "trades." They cover nearly half of the earth's surface and their name is derived from the steadiness with which they blow. They often blow for perhaps a week in an unchanged direction. They carry few clouds and as they approach the equator their velocity increases and clouds become more frequent.

The winds blowing from the "horse latitudes" poleward are called "prevailing westerlies." In the southern hemisphere the velocity is greater than in the northern hemisphere and are often called the "roaring forties." The Germans apparently failed to consider, before inaugurating their first gas attack, that Europe lies in the region of the prevailing westerlies and that the prevailing winds of western Europe would be more favorable to the Allies than to themselves.

AT the seashore the land is heated more than the adjacent ocean during the day, and at night by rapid cooling becomes colder than the adjacent water. This gives rise to a small convectional circulation known as land and sea breezes. The sea breeze begins about ten or eleven o'clock in the morning and blows gently but with increasing velocity from the ocean toward the land. It does not usually penetrate more than ten or fifteen miles inland and it reaches its maximum velocity at about two or three o'clock in the afternoon. At about sunset the sea breeze dies out and it is replaced during the night by the land breeze, which blows from the land towards the sea. The sea breeze is usually more marked and has a higher velocity than the land breeze. The velocity and direction of the wind along sea coasts would exert a marked influence on the use of chemicals in warfare during landing operations.

Mountain and valley breezes are well known in all mountainous countries. During the night the layer of air next to the ground becomes cooled and thus more dense and drains, just as water would, into the valleys and places of less elevation than the surrounding regions. During the day the opposite effect is noticed. From a few hours after sunset until early morning, the mountain breeze flows down from the mountains through the valleys to the plains below. During the day the valley breeze is felt as a gentle breeze flowing up through the valley and up the mountain slopes. These breezes would play an important part in directing military operations in a mountainous country. In pitching camp in a mountainous country it is very desirable to build camp fires on the down hill side, so that the valley breeze may blow the smoke away. The location of the camp is of equal importance, especially if there is any chance of encountering poisonous gases. The movement of the air currents would cause a heavy concentration of gases in the valleys and places of low depression.

EXTRATROPICAL cyclones ("lows") are whirling storms which occur outside the tropics and are commonly spoken of as "lows." They are areas of low barometric pressure with spirally inflowing winds turning counter-clockwise in the northern hemisphere. The wind velocity is generally moderate, the accompanying cloud area is immense, precipitation usually falls, and the changes in temperature and moisture are large and well marked. The whole formation is from a few hundred to several thousand miles in area and moves with moderate velocity from some westerly to some easterly quarter.

The first signs of the approach of a "low" are usually these: The wind begins to blow gently from the east, the pressure

decreases slightly, cirrus clouds make their appearance, and the temperature and moisture begin to increase. Next the barometer drops still further, the wind direction changes to the southeast and the velocity becomes a little greater and the temperature and moisture continue to rise. In winter, we usually say, the weather has begun to moderate. The pressure continues to drop still more, the winds veer a little and blow harder and the temperature and moisture are high and still increasing. Next comes a period of rain or snow, with the barometer still dropping and finally reaching its lowest. The wind, in the meantime, has slackened somewhat and veered a little and is now blowing from the south or southwest. The barometer now begins to rise, the precipitation grows less and the temperature and moisture decrease. The wind veers rather quickly into the southwest, then west and finally northwest, and continues to blow from the northwest with increasing velocity. The barometer rises, the temperature drops rapidly and the air becomes much dryer. In summer, the dry, cool, northwest wind replaces the oppressive sultriness of a few days before, and in winter, the thaw or warm spell has been replaced by a cold snap. How often have we seen such a sequence of weather without realizing that we were experiencing the passage of an extratropical cyclone. This series of weather changes requires from two to four days in winter for its completion and nearly double the time in summer. Also, this series of weather changes applies to a nearly central passage and if it passes to the north or south the sequence would be different, depending upon the distance of the center of the "low."

Anticyclones (highs) are areas of high barometric pressure with spirally outflowing winds turning clockwise in the northern hemisphere and counter-clockwise in the southern. Just as two valleys are an impossibility without a hill or ridge between them, in the same way two areas of low pressure cannot exist without a region of high pressure between. These areas of high pressure have many characteristics which are exactly the opposite of "lows." The wind velocity is usually very moderate, calms are frequent, few clouds are seen and precipitation is usually lacking. The whole formation is somewhat larger than a "low" and moves in the same general direction.

TAKING the northern hemisphere as a whole, the lows move eastward and slightly poleward. The reason for this eastward movement is that this is the prevailing direction of both the surface winds and the fast moving upper air currents. "Lows" may originate anywhere. In the United States a favorable place of origin is the Mississippi valley just east of the Rocky Mountains. They seem to prefer to travel along certain rather definite paths. If a "low" does not originate in the United States, it enters it from the northwest, west or south. Those that enter north of the middle of the country have a tendency, in crossing the Mississippi valley, to move towards the south and then recurve towards the northeast. In approaching the Atlantic coast, all lows move toward the northeast and generally leave by the St. Lawrence valley. The average velocity of motion is about 31.7 miles per hour. The velocity in winter is about double that in summer and this is true the world over. While the average velocity of motion is 31.7 miles per hour, one "low" may loiter for a day or two while another one may rush across the country, covering a distance of sixteen or seventeen hundred miles in a single day.

"Highs" are more erratic than "lows," both as regards the track followed and the velocity of motion. "Highs" usually enter the United States from the extreme northwest or over California. Those that enter from the northwest usually follow one of two paths; they may move eastward and slightly southward along the northern boundary of the United States until the Atlantic coast is reached, where they turn toward the northeast and proceed in the direction of Iceland, or they may move southeast over Kansas and the Gulf States to the Atlantic coast near Florida. Those that come in over California usually move southeast and join the usual track just south of Kansas. After leaving the Atlantic coast, near Florida, they usually continue to move towards the southeast in the direction of Bermuda. The velocity of motion averages somewhat less than that of "lows," which is due to some "highs" remaining almost stationary for a day or two and perhaps a week, and thus brings down the average velocity of motion.

TO forecast or predict the weather is to foretell the values which the meteorological elements (temperature, pressure, wind, humidity, clouds, and precipitation) are expected to have. The ability to do this is the most important result of study of meteorology, but one which can only come with study and practice. In time of peace in the United States we do not have to worry greatly over the weather for we have the Weather Bureau to make our observations and forecasts and all that we have to do is to turn to the daily paper and we have our weather forecasts before use. In time of war, however, the success of military operations may depend entirely upon the ability to make and interpret observations and make local forecasts.

There are three factors which enter into weather forecasting: (1) the typical or normal condition of the atmosphere which would exist if there were no disturbances or local influences; (2) disturbances caused by "highs" and "lows," thundershowers, etc.; (3) local influence such as land and sea breezes, presence of large bodies of warm water, mountains, etc. Of these three factors, the ones which exert the chief influence on the weather in the United States are "lows and highs."

If "highs" and "lows" were always typical, weather forecasting would be an easy matter. As it is, weather forecasting is by no means easy, as "lows" and "highs" are seldom typical as regards path, velocity or characteristics. Weather forecasting, then, really turns to this one thing, the estimation of the influence of the passing meteorological formations. The first thing to do is to estimate the influence which the passing formation is going to exert one or two days in the future. The local influence must next be estimated. When these two have been combined with normal weather, the resultant is the expected or predicted weather.

When the wind sets in from points between south and southeast and the barometer falls steadily, a storm is approaching from the west or northwest, and its center will pass near or to the north of the observer within twelve to twenty-four hours, with winds shifting to the northwest by way of southwest and west. When the wind sets in between points between east and northeast, and the barometer falls rapidly, a storm is approaching from the south or southwest, and its center will pass near or to the south or east of the observer within twelve to twenty-four hours, with winds to the northwest by the way of north. The rapidity of the storm's approach and its intensity will be indicated by the rate and the amount of the fall in the barometer.

Facts, Pacifism and Ink

Some Basic Propositions of Peace and War

By Lieut. Col. C. L. Hall*

OCEANS of ink, and a considerable amount of good feeling, are being expended in the United States in the course of a furious debate on external peace. One group declares that the way to secure perfect peace is for all nations to disarm, for then violence will not be resorted to in international relations. This group may be called the pacifist section. Another group, composed generally of persons of patriotic feeling but with limited historical perspective, declare that the only object of military and naval forces in America is to defend the country from a cruel aggressor. These forces must be adequate for defense, but not for aggression; and then American peace will be preserved. This group may be called (although it vigorously denies the name) the militarist section. The two sections are strenuous speechmakers, and both of them are more or less convinced that all adherents of the other section are potentially, if not actually, unmoral. It is somewhat difficult for a realist to analyze this debate, since the state protected by its own defenselessness and the military force adequate for defense but incapable of aggression are alike figments of the imagination. Still, it is curious that, however furiously the two sides may berate each other, their basic moral dogma is the same: namely, that there is something almost sacred about the *status quo,* and that the disturber of it is a criminal. Neither group ever seems to have heard of the philosophical principle that the ethical propriety of any situation depends upon the circumstances of its origin.

WHEN the writer returned from France in 1919, he expressed the belief that the Treaty of Versailles was inherently unstable, and that the retention by the Allies of German prisoners of war after the Armistice, and the maintenance of the Allied blockade, were crimes against civilization. He found himself regarded by a substantial portion of his non-professional acquaintances as certainly a pro-German, and probably a traitor. Many of these persons held that no armistice should have been signed, and that casualties should have continued—on both sides—until Berlin was captured. Many of his present civilian acquaintances—some of them the identical individuals who once regarded him as a traitor—now declare that no war is justified, and that war can be prevented by the elimination of the military and naval professions, the destruction of armament, and the erection of international courts. This article is an effort to apply the laws of thought to the problem of the function of war.—AUTHOR.

THE *status quo,* so sacred both to pacifists and to militarists, rests, as far as this continent is concerned, upon four basic documents. These are the Treaty of Paris of 1782, which ended the Revolutionary War; the Treaty of Paris of 1803, which provided for the cession of Louisiana to the United States; the Treaty of Guadalupe Hidalgo of 1848, which ended the Mexican War; and the Treaty of Washington of 1846 which extended the frontier of the 49th parallel to the Pacific Ocean. There are, of course, areas within our country covered by other documents, like the Gadsden and Florida Purchases, but the four agreements named are the basic ones. The first treaty, that which ended the Revolutionary War, was secured by the unabashed destruction of the *status quo* by military force. There was a kind of a moral basis to the document, since it probably represented the views of a majority of the persons affected, but it presents no triumph of the virtues of nonaggression. The treaty with France for the cession of Louisiana was peaceful in form, but was procured by the threat of force—entirely in the opinion of some writers, but not of others. Bonaparte was well aware that his American friends would be unable to control the hostility of the West if the Mississippi were not opened. There might even be an Anglo-American alliance if France remained astride the mouth of that stream. Except as Hayti had disgusted Bonaparte with America, the cession was a triumph of the big stick, and not of moral or legal rights. The treaty of Guadalupe Hidalgo was openly extorted at the point of a bayonet from a helpless and weaker foe. The Northwestern Treaty was, strictly speaking, a compromise between two white thieves for the division of staked out, but as yet unexploited, Indian lands. Either one who occupied the territory, which was in the possession of aborigines, would have a better title to it than the other. The treaty represents a triumph of the threat of force by England against the United States. A presidential election had been conducted partly on the basis of "Fifty-four forty or fight." Neither event occurred, because our military force was insufficient. The four basic treaties described above were supplemented over the course of a century by a series of openly forcible operations against the weaker aborigines, carried on partly by a regular army, which usually sympathized with its enemy, and partly by pioneers whose cheerful moral doctrine was that "the only good Indian is a dead Indian." The results of these wars were consecrated in a series of treaties with the Indians which were described in a forgotten book of two generations ago called *"A Century of National Dishonor."* There is certainly not much foundation in this record for the dogma of an ethical *status quo.*

Physical history supports documentary history. Two of the external wars which the United States fought, those with Mexico and Spain, were admittedly aggressive both in form and in object, and were designed to alter the international status by the exercise of naked force. The objects of the War of 1812 were equally aggressive, though a little more disguise was used. Since this war, as far as our country was concerned, was a failure, it had no permanent effect on the

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international situation. However, a study of its origin supports the theory that this country was not then wedded to any given external situation. The war with Germany is too recent to require discussion.

All American foreign wars have involved a comparatively small loss of American life. The war *par excellence,* in the history of the new world, is the War of Secession of 1861-65. It is interesting to note that, when this war started, armament on both sides was practically nil, the few members of the military and naval profession employed in the country were nearly all bitterly opposed to a fraternal war, and the relations between the parties were governed by a document more rigid and better provided with impartial courts for its interpretation than any arbitral treaty ever will be. There is not much comfort here for the notion that wars are produced by armament, by militarists, or by the absence of competent tribunals. In the War of Secession, both sides were agreed that the war was aggressive, but they differed as to which was the aggressor. The conflict was fought out between historians and legal scholars for two generations after the war was over. It has finally ceased, not because any decision was reached but because neutral professors have now generally agreed that the cause of the war was the inability of the states peacefully to adjust the political status to the shifting economic and cultural conditions of the age. This is the conclusion generally reached about any war by neutral professors—two generations after the war is over.

The erection of a moral superstructure for the *status quo* on this continent upon diplomatic history as a foundation would appear to be a task too great for any moralist. But it has not been too great for either pacifists or militarists. Both are continuing their furious debate with this doctrine as an axiom. The conflict might remind an independent observer of an argument in scholastic philosophy, like the celebrated quarrel as to the number of angels who could stand on a needle's point, since it is referred to an imaginary planet, inhabited by persons with the outward physical appearance of human beings, but with mental characteristics having no discoverable relation to those of any known variety of *homo sapiens.*

INDEED, poor old *homo sapiens* has little to do with the affair. Of all defenses of war, those based on biological grounds are probably the most ridiculous. Man, considered as a carniverous animal, inherits no tendency to war. Our anthropoid ancestors fought with each other about a mate or about food but the fights were individual and there were no gang-fights. Gangs were formed, as they are throughout the entire animal kingdom, to attack groups composed of other species. It was only in early neolithic times—or yesterday as geologists figure it—that the various gangs, having gained their conflict with lower animals, began to quarrel with each other. War is no biologically inherited instinct—it is a disease of man-in-society.

The science which deals with man-in-society is called politics, and war must be studied as a form of politics—"a continuance of political action by other methods," as Clausewitz puts it. In the "Esprit des Lois" Montesquieu showed that every political action must be either executive, legislative or judicial. As war is obviously a dispute—and as the dispute with which we are familiar domestically is a disagreement as to what the law is, or what the facts are—superficially minded persons usually declare that war results from a judicial dispute, capable of settlement by some sort of court, if one of sufficient authority and impartiality were in existence. Individuals may quarrel about what the law is, but groups of individuals quarrel about what the law ought to be. The industrial revolution altered the relations of master and servant in industry. During the last 150 years these relations have been readjusted by a long course of what amounts to limited warfare. At no time have those on the aggressive (generally labor) been willing to admit that their relations should be governed by what the law happened to be at that particular moment, and in no case have the decisions at the end of the conflict been judicial in character.

Exactly the same series of events occurs in the international field. Our war against Mexico was fought because the persons in control of American public life thought that it would be to the advantage of a greater number of persons for the southwest to be under American control rather than for it to be governed from the City of Mexico. In 1898 the American people decided that the law under which the Spanish Crown had a perfect legal right to govern Cuba had become an unmitigated nuisance and ought to be changed. The prospective wars of the future, about which all the world is now talking, will also be legislative in character. There is no doubt that under the existing law the Magyar districts around Pressburg (Bratislava) are Czech. The dispute between Hungary and its Czechoslovakian neighbor is as to whether this law ought to be changed. The great dispute in the Far East is not about what the law is, of which there is very little doubt, but about what the law ought to be for the government of the enormous territory northwest of Korea,—the world and its people being what they are. Not a single one of these disputes touches on any serious disagreement as to the meaning of any existing document. Where such verbal disputes occurred in the past, they were really based not on what the meaning was but on what it ought to be.

It is impossible to find any instance of radical international legislation affecting any controversial subject which has ever been put into force by purely peaceful means. A few *prima facie* cases can be found, like the separation between Belgium and Holland in 1830; but here the necessary treaties were signed only as the result of threatened force applied by other powers. Where the legislation has been the result of free compromise, each of the states affected has noted the value of the military forces of the other in reaching a decision as to its own attitude; and accordingly force has entered into that decision. Such was notoriously the case in the instance of the British and American Governments when they were settling the question of the extension of the 49th parallel, to which reference has already been made. Cases can be found of radical alteration of the *status quo* as a result of war, or of threatened war, or of a joint threat of external force applied by several stronger powers to two weaker antagonists. Cases of alterations as a fruit of reasoning cannot be found.

The argument has now sufficiently advanced to permit the statement of the first proposition:

1. *War is a means of altering the international status, (i.e. of enacting international legislation); and seldom has any other function. It is the only means for this purpose now available.*

WRITERS on international peace have some appreciation of the truth of the foregoing proposition, and are now busily engaged in seeking to preserve indefinitely the present international situation. This quest, in shorter language, is an attempt to "freeze the *status quo.*" The easiest way to show

the hopelessness of this endeavor is to consider the subject historically, to pick out any desired past date, and to determine whether any conceivable governmental processes could have preserved the then existing situation.

For purposes of argument, the date A. D. 1500 will serve as well as any other. If the international situation had remained frozen from that day to this, Spain would be occupying Cuba, Haiti and Porto Rico. Mexico would be an Aztec state, and Peru an Inca one. The rest of the American continent would be occupied by a group of nomadic tribes whose territory, presumably, the world's white population would not be seeking, and who would not themselves be subject to enslavement by semicivilized Aztecs and Incas. New Zealand would be a kind of cannibal confederacy. On the continent of Europe the Holy Roman Empire would still function over an area provided with approximately two hundred and fifty interior frontiers. Calais would be an English colony on the coast of France. The Balkan states would be Ottoman fiefs. The exact frontiers which Africa would have had can only be determined by archaeologists. India would be a Mogul Empire. No vessel flying a flag other than that of Spain would have a legal right to dock at any American port, and no European vessel flying any flag but that of Portugal would have a legal right to dock at any port in Africa outside of the Mediterranean.

It is enough to describe the situation of A. D. 1500 as the imaginary political geography of this century to show that human beings would not have stood it for more than four hundred years unless they had been held in subjection by some superior force, moral or physical. The authors of the Covenant of the League of Nations appeared to understand that some alterations in international relations would be required from time to time, and prescribed a method which may be termed that of unanimous consent. During the time the Covenant has been in existence, consent has been granted for various alterations in the internal conditions of the defeated powers, but none has ever been obtainable for any alteration in international frontiers. The authors of the report on Manchuria, submitted to the Council of the League of Nations, clearly recognized that the Manchurian situation, as it existed in law, could not be justified on rational grounds but were unable to prescribe any formula or reasonable alterations satisfactory to all the parties in interest. They were equally unable to prevent the exercise of force by Japan to secure alterations, which were presumably in excess of those deemed justifiable by the League Committee, but which nevertheless could be enforced by the physical means available. Here was a clear case where every one recognized that the *status quo,* which had only been frozen in 1906, had become completely out of date. With settled areas of the same general cultural level a longer life for a satisfactory status (if one is ever found) can be predicted, but no one can properly predict an indefinite life for any situation.

Writers of the moralist school have sometimes claimed that the evils of inapplicable frontiers are less than the evils of attempting any alteration of them. It is difficult to discuss this doctrine rationally, because the words *good* and *bad* have no very exact meaning in history. Great historical movements, like that which overwhelmed the Roman Empire and that which was set in motion by Columbus' discovery of America, cannot be discussed in terms of private morality. What can be confidently stated is that no frontier system has been preserved after there was no longer available to those who would preserve it a balance of force sufficient to restrain masses of human beings—organized or unorganized—who were fully convinced that the frontiers in question were no longer applicable. It is impossible to say, for instance, whether the Texans whose names are associated with Crockett and Houston were better or worse than the sleepy Spanish proprietors who had previously led a peaceful existence in the valley of the Brazos. Probably no Mexican Government was ever strong enough either to withstand or to concede the demands of the Texans for relief from what they felt was an impossible situation. Some alteration of the *status quo* was obviously required but Mexico could hardly have been expected to surrender an historically legitimate right, together with the interests of compatriots of their own who had done nothing to invite this invasion, except under the influence of force, of threats of force, or of some enormously superior moral compulsion.

It is now possible to state the second proposition. In order to make the argument continuous, the first proposition is repeated:

I. War is a means of altering the international status, (i.e. of enacting international legislation); and seldom has any other function. It is the only means for this purpose now available.

II. *Some means of international legislation must exist.*

From these two propositions the third follows automatically:

III. *In order to avoid war, a peaceful instrument of international legislation must be provided.*

THERE has not been much discussion of the construction of an international legislature but there has been some. It is not necessary to enter into what Carlyle calls "a Constitutional discussion of Kilkenny Cats." Bases of representation and bases of electorates are futile topics until the nature of the medium in which the legislature is to have sway is properly analyzed. Light on this subject can most readily be gained by a study of the history of the formation of federations, since federations have often been formed to prevent quarrels between their members.

In all federations having central legislative power, certain rules are laid down for the relation of the legislature to the member states of the federation and to their individual inhabitants; some rules are usually laid down for the relations of the state governments to the inhabitants of other states. This was recognized for instance at the American Constitutional Convention of 1787 where, at the outset of the discussion, it was accepted that "no tax or duty shall be laid on articles exported from any state," and that "citizens of each state shall be entitled to all privileges and immunities of citizens in the several states." Similar provisions were accepted without discussion at the time of the formation of the Australian Commonwealth and later when the Union of South Africa was formed. These terms are the common law expressions of the doctrines of freedom of trade and freedom of migration within the area subject to the legislature by all persons having any voice in its selection. They are bases which must be agreed upon before the form of a legislature can be intelligently discussed.

It would of course be possible to extend the direct historical proof by introducing many other instances of similar federal constitutions. It seems hardly necessary. Negative historical proof, that a federation with an international legislature cannot continue after freedom of migration, or freedom of trade, is destroyed, is somewhat more difficult to establish. The reason is that the tendency of federations is to centralize

power and, hence, rebellion by dissatisfied groups may replace secession by a state as a cause of federal collapse. It is, however, interesting to note that, at the time of the secession of 1861, the argument that freedom of migration had been denied was one of the reasons adduced to justify the secession. While no claim was made that individual citizens of the seceding states had been prevented from moving, it was claimed that they had been prevented from moving with their property (i.e. slaves) and that this denial constituted a moral breach of what was universally regarded as one of the bases of the constitution. The control of trade by the Athenian Government during the life of the Confederacy of Delos made the so-called legislature of that confederacy a mere machine for registering Athenian wishes. The fact that freedom of trade does not exist throughout the British Empire is one of the reasons accepted by all writers on British constitutional law for the impossibility of establishing a central Parliament. It was the inability to agree on internal freedom of trade which prevented the union of Newfoundland with the Dominion of Canada, and the union of New Zealand with the Australian Commonwealth. No one even suggested that the Dominion parliaments could function over areas not subject to internal free trade.

The theory that freedom of trade and freedom of migration are indispensable prerequisites to the formation of an international legislature can be supported by processes of reasoning as well as by historical argument. There is a mystic symbolism in a frontier of any considerable duration which makes inhabitants on both sides very unwilling to give it up. So strong is this feeling on the part of human beings who have identified their fate (as most men have) with the nation to which they belong, that the constitutions of the federations nearly always prevent any interference by the central legislature with the existing frontiers of their members, except with the consent of the parties affected. What American would accept a federation whose legislature, through a combination of European and South American votes, could transfer El Paso and San Diego to Latin America? If the internal frontiers had the economic and cultural significance of international frontiers, so that alterations in the character of the frontier population called forth frontier differences, the life of federations would indeed be short. But the principles of freedom of trade and freedom of migration overcome the sanctity of frontiers, not by altering their situation but by diminishing their significance. A man who can move himself, or his factory, or the goods which he produces, across an imaginary line without economic or political discomfort ceases to care much exactly where that line is. Moreover, through this freedom, there are heavy periodic movements of individuals in search of better livelihood, to whom the frontiers gradually become meaningless and not worth fighting over. Any restriction of these freedoms reëstablishes the significance of the frontier, and, if the cultural and economic conditions on the two sides are in a state of flux, the political status gradually becomes inapplicable. The same conditions which tend to embitter relations between adjoining states would then tend to embitter relations between the members of federations, and would thus destroy all the moral authority of the federation's legislature.

The fourth proposition can now be stated, the first three being again repeated for clarity of argument:

I. War is a means of altering the international status, (i.e. of enacting international legislation); and seldom has any other function. It is the only means now available.

II. Some means of international legislation must exist.

III. In order to avoid war a peaceful instrument of international legislation must be provided.

IV. *An international legislature cannot function except in a world enjoying freedom of trade and freedom of migration.*

From these four propositions the fifth follows automatically:

V. *As a prerequisite to the prevention of war, there must be established freedom of trade and freedom of migration.*

THERE is room for legitimate difference of opinion as to whether the establishment of these two personal liberties would benefit the members of the human race as a whole. Writers on the history of federations would generally agree that the benefits of their establishment would counter-balance their evils—in the long run. But it is quite clear that they would injure vested interests vital to a majority of the populations of many areas and would practically destroy the racial character of those states having a relatively low rate of population increase. Discussion of the matter, however, is not very useful, because a proposal of this character is not "practical politics." The Briand scheme for European federation never reached serious discussion because of exactly this question. The industrially backward states were unwilling to become mere farms for the industrially advanced states, as the absence of manufactures would destroy their force as nations. The industrially advanced states were unwilling to sacrifice their agriculture to the rural states, because that would mean that they would be utterly unable to support their populations during a conflict. In the United States, military considerations do not enter into the argument so forcefully. But labor is convinced that its standards of living depend on the exclusion of culturally inferior aliens, as, indeed from a short term point of view, they obviously do. Capital is convinced that the abolition of the protective tariff would destroy the utility of such a mass of fixed capital that industry would be ruined. Against the opposition of labor and capital combined, no political theory can make itself heard—much less listened to.

The man who is in favor of universal peace, complete freedom of trade, and complete freedom of migration is entitled to respect as a sincere and logical reformer—though he may be regarded, with some justice, as a doctrinaire. The man who is in favor of universal peace, Chinese exclusion, and the protective tariff is talking through his hat—and not a very large hat at that. Until freedom of trade and freedom of migration are established, there can be no international legislature. Until an international legislature is established there can be no peaceful means of altering the *status quo*. Until rates of increase of population, economic conditions and culture are all simultaneously stabilized, the *status quo* must from time to time be altered. These alterations will be procured, not by a balance of votes, but by a balance of force. In determining this balance, direct military and naval strength is, admittedly, only one element—but it is a vital element. The international legislation of the future, like that of the past, will be settled by hard facts—usually very hard facts indeed—and not by pacifism or ink.

The November-December Issue of
ARMY ORDNANCE
will contain complete accounts (including verbatim reports of addresses) of the sessions of the Association's Seventeenth Annual Meeting, October 2 and 3, 1935.

ARMY ORDNANCE

Published Bimonthly by
THE ARMY ORDNANCE ASSOCIATION
WASHINGTON, D. C.

SEPTEMBER-OCTOBER, 1935

Month by Month

ON October 2 and 3, 1935, when the Association's Seventeenth Annual Meeting was held, history was in the making. Three American citizens renowned for their services to the national defense were honored as recipients of the Association's medal, pronouncements of far-reaching effect as to the meaning and urgency of industrial preparedness were made and American industry was again given the opportunity to observe at first hand the character and intricacy of modern armament. This issue of ARMY ORDNANCE goes to press with the addresses and demonstrations still ringing in one's ears and the country-wide reverberations of general approval pouring in. Unfortunately there is not time to assemble the addresses nor to prepare an adequate account of Ordnance Day. The November-December issue will be devoted to complete transcriptions of the words of General Crowell, our President, Hon. Newton D. Baker, Hon. Bernard M. Baruch and Col. Rogers Birnie, our medalists, and of Mr. Ralph Flanders, President of the American Society of Mechanical Engineers. The editors will attempt in an illustrated article to describe Ordnance Day at Aberdeen in that number. Taken altogether, the November-December issue of ARMY ORDNANCE should be a prized possession for the present and future. The addresses will be reissued in pamphlet form for gratuitous distribution to any members who may want to have them.

HISTORY IN THE MAKING

At this writing there are impelling reasons why thanks and congratulation should be extended without delay. The foremost among the objects of our thanks are the distinguished medalists whose pronouncements gave a new spirit of assurance and a new determination of effort to the 250-odd who were fortunate enough to hear them. These speakers demonstrated again the soundness of industrial preparedness, issued a clarion call to sound thinking and manly approach to the problem of armament as a phase of the peace-time responsibility of our national defense.

Ordnance Day 1935 met with the general acclaim of all members and guests. For this the War Department deserves highest praise. The Secretary of War having approved the reëstablishment of Ordnance Day, the Department as a whole contributed splendidly to its success. Maj. Gen. William H. Tschappat, Chief of Ordnance, again displayed his fine spirit of coöperation and Col. Charles M. Wesson, Commanding Officer of the Proving Ground, arranged and executed a most interesting and delightful program. To them and to the many officers of the Department who gave of their best effort the Association and its friends are grateful. To mention all by name would be to recount in profusion the many tasks and functions performed. One in particular, however, deserves highest praise. As special assistant to the Commanding Officer of the Proving Ground he planned and arranged the many details incident to the tests and demonstrations. We refer to Capt. Thomas K. Vincent who as a representative of Colonel Wesson was responsible for the many arrangements.

It is significant, we think, that after seventeen years the Ordnance cause under the sponsorship of the Army Ordnance Association continues to elicit so much general interest. An analysis of the reasons why this is so must surely reveal that the lessons of industrial preparedness are very much alive among our people and that the passage of time has tended to increase the loyal interest of the civilian component in the needs and responsibilities of adequate armament for our national defense. The account to appear in the November-December issue will take into consideration these and other incidents of the Seventeenth Annual Meeting which made history.

ONE of the announced purposes of the arms control legislation is to publicize periodically the quantity of arms, ammunition and implements of war exported from and imported into the United States. We have called attention time and again to the fact that the statistics of our arms exports are public property and have been for the past thirteen years. The new legislation in this respect will put the figures in different form. That this feature of the legislation will be productive of any real value is very problematical.

MUNITIONS CONTROL

Under the control legislation certain types of information not heretofore available will be furnished but even this will not change the insignificant size of our so-called arms exports. The latest available statistics compiled by the Bureau of Foreign and Domestic Commerce for August, 1935, are of especial value, preceding—as they do—the period when the new measures go into effect. It might be well to bear these figures in mind for later comparison with those to be published six months or a year from now under the new system. Readers interested in such comparison may make note of the following: During August, 1935, there were exported from the United States a total of 942 pistols and revolvers valued at $18,753. The largest recipient was Cuba to which were shipped 580 valued at $12,305. The next largest consignee was Brazil which received 215 valued at $3,773. To Peru were shipped 60, British India 39, Germany 13, Colombia 12, British Malaya 10, Venezuela 5, Canada 4, Philippines 2, Iraq 1, Italy 0, Ethiopia 0. For the same month 4,187 rifles (not necessarily military) valued

at $32,492 were shipped. Australia took by far the largest consignment, 1,888, Canada 866, New Zealand 326, Irish Free State 275, United Kingdom 135 and all other countries in small varying amounts from 1 to 96. The August report shows under the heading of "machine and heavy guns and gun carriages" a shipment of 91 units valued at $165,201. Of these 88 were shipped to Turkey, 3 to Cuba. The value of metallic cartridges, shells and projectiles for August was $114,434 in varying quantities.

The total value of all these arms exports was $341,547 spread among some 44 separate countries. Rather difficult to believe that so minute a business even under the threat of war can be worthy of the prominence politicians have given it or capable of the effects politicians attribute to it! It will be very interesting to watch the operations of the new licensing system. At the end of a year it should disprove better than anything else the flimsy logic of those who blame war on the armament makers. And isn't it curious, to say the least, that some of our elaborate magazines, not to mention United States Senators, have not blamed the present European crisis on the "munitions makers"? In 1934 "munitions makers" were discovered to have caused the war of 1914-1918. Twenty years from now some socialistic investigators will probably make the same charge about the Italo-Ethiopian trouble! However, the articles listed below are those considered to be armament in accordance with Section 2 of the Joint Resolution providing for "the prohibition of the export of arms, ammunition and implements of war to belligerent countries and . . . for the registration and licensing of persons engaged in the business of manufacturing, exporting or importing such articles":

Category I. 1. Rifles and carbines using ammunition in excess of cal. 26.5, and their barrels; 2. Machine guns, automatic rifles, and machine pistols of all calibers, and their barrels; 3. Guns, howitzers and mortars of all calibers, their mountings and barrels; 4. Ammunition for the arms enumerated under (1) and (2) above, i.e., high-power steel-jacketed ammunition in excess of cal. 26.5; filled and unfilled projectiles and propellants with a web thickness of .015 inch or greater for the projectiles of the arms enumerated under (3), above; 5. Grenades, bombs, torpedoes and mines, filled or unfilled, and apparatus for their use or discharge; 6. Tanks, military armored vehicles and armored trains.

Category II. Vessels of war of all kinds, including aircraft carriers and submarines.

Category III. 1. Aircraft, assembled or dismantled, both heavier and lighter than air, which are designed, adapted and intended for aërial combat by the use of machine guns or of artillery, or for the carrying and dropping of bombs, or which are equipped with, or which by reason of design or construction, are prepared for, any of the appliances referred to in paragraph (2), below. 2. Aërial gun mounts and frames, bomb racks, torpedo carriers and bomb or torpedo release mechanisms.

Category IV. Revolvers and automatic pistols of a weight in excess of 1 pound 6 ounces (630 grams), using ammunition in excess of cal. 26.5 and ammunition therefor.

Category V. 1. Aircraft, assembled or dismantled, both heavier and lighter than air, other than those included in Category III. 2. Propellers of air screws, fuselages, hulls, tail units and undercarriage units. 3. Aircraft engines.

Category VI. 1. Livens projectors and flame throwers. 2. Mustard gas, lewisite, ethyl- and methyl-dichlorarisine.

A RECENT dispatch from Mr. John W. White, correspondent of the *New York Times* at Buenos Aires may have created at least a guilty look on the faces of some of our politico-pacifist friends. Mr. White's story recounts that peace negotiations between Bolivia and Paraguay, having been at a standstill since the Chaco War was halted many weeks ago, will probably be arranged by the *military* leaders of the respective sides. General Enrique Penaranda del Castillo for Bolivia and General José Felix Estigarrilia for Paraguay, were reported hard at work *for peace*. The curious part of the story is this: "Observers here (Buenos Aires) find much significance in the fact that the two generals are meeting on a cordial basis and negotiating in a friendly give-and-take spirit while the two peace delegations from the very beginning have stubbornly refused to budge an inch from their irreconcilable stands. . . . Friends of Generals Estigarrilia and Penaranda who have arrived here since the Armistice was arranged quote both as declaring their determination not to permit the politicians to interfere with peace."

GENERALS AS PEACE MAKERS

Read it once more! Can this be? Anybody so decidedly militaristic as a general wanting peace and insisting on it? Such a thing will be as impossible for the ladies of the We See To You in annual convention to believe as their ideas regarding liquor advertisements—or liquor without the advertisements—are to change. Mr. White must have been misinformed! Generals never want peace—blood thirsty as shave tail lieutenants, their thirst for blood is insatiate by the time they become colonels. Mr. White can't be right! Statesmen are the peace makers, generals the war makers. It couldn't have been General Grant who allowed the surrendered troops of Lee to keep their horses for the spring plowing. Military men just don't do that sort of thing.

We imagine the critics of anything and everything military do not like such stories as Mr. White's in the press. Such accounts no more square up with pacifist ravings than pacifist ravings square up with facts. The facts: generals as peace makers are performing their principal function; when generals make war they do so only to bring peace and when statesmen cannot follow up with their part of the job then the generals do that too. So a closing injunction to Mr. White—please don't ask us to believe that statesmen are gumming the works. Generals are noted for doing just that—statesmen never!

MAJ. GEN. WILLIAM C. RIVERS, Retired, has performed a distinct public service by making available in pamphlet form his views on our changing national defense. The text was originally presented, by invitation, at a public hearing before the House Committee on Military Affairs on April 4, 1935. About 25,000 words in length, the pamphlet is accompanied by a great circle chart of the Pacific and a sketch map of the United States showing the corps area and army boundaries and the location of Army posts and stations.

OUR CHANGING NATIONAL DEFENSE

In this study the author crystallizes his 47 years of army service, including participation in three overseas campaigns. We are not concerned primarily here with some of General Rivers' proposals which include a single department of national defense, an air corps separate from the Army and

Navy, the consolidation of service schools in one training center in order that a war strength brigade or skeleton division might be available, and the old political chestnut of returning obsolete army posts to states, counties and municipalities for park use. These are topics on which competent opinion in some cases is unanimous and in others extremely divergent.

The point we wish to make relates both to the authorship and to the subject matter of General Rivers' discussion. As to authorship, "Our Changing National Defense" is the view of an experienced professional mind. Forty-seven years of experience is not to be winked at in any field of endeavor. The energy and zeal which now crystallize that experience in the author's statement of desired policy have an intrinsic value which should not be allowed to go begging. It is a curious fact with us in the United States that the members of our military profession, highly educated and widely experienced as they are, immediately they retire from active service are shelved, as it were, and consigned to some sort of military limbo where they remain in a state of suspended animation. In the affections of their associates they rank high but in the guidance of those who follow after, their voices are too frequently hushed and their counsel too often unsought. This is not true in the other professions and the military loses by the practice. Our surgeons, lawyers and engineers are given added faith and credit by reason of their experience; our generals the moment they hit the age of retirement are left to execute their strategy on the golf course in the morning, campaign at the bridge table in the afternoon and either read the masters or twiddle their thumbs in the evening. And yet their intellectual processes based on priceless experience are a reservoir of fact and theory of inestimable value to their profession. Therefore there should be jubilation in the ranks when the competent retired officer, whether one agrees or disagrees with him, continues to give his profession the benefit of his views. In this respect at least General Rivers is rendering a distinct service. Memoirs of the military strategist, tactician, engineer and administrator, issued at the end of praiseworthy service, are quite alright but what is wanted and what students need is current advice and rebuttal.

As to subject matter, our national defense *is* changing. We have indicated at greater length elsewhere in these editorial columns how we think it is. Military science would not be a science at all if there were no change. Philosophers no doubt will tell us that where there is change it is essential that we know the origin as well as the destination; what we are changing *from* no less than what we are changing *to*. Granted the process of change, where else will a profession—any profession—get its essential bearings unless the masters of the former system counsel the directors of the present and the future? The worst thing that can be said of the military outlook—and history proves the point—is that it tends to become static. Change is essential to national defense so that to lull one's self into the belief that standardization and rule of thumb methods are fixed ones after all is nothing less than rank heresy. If national defense for us is to be kept virile it must be stimulated by the expression of qualified, competent thought where the merit or demerit of all proposals are viewed in their proper weight and relation. In this field our inactive leaders are invaluable. General Rivers on "Our Changing National Defense" can well lead the way for our other inactive military leaders to follow suit. In age there is wisdom.

A Friend of the Services

THIS year the *Scientific American*—our country's venerable but alert publication of technical progress—is observing its ninetieth anniversary. Quite appropriately the enlarged November issue is dedicated to the United States Navy. The Navy number comes at a time when sound discussion of the principles underlying our naval defense and the organization of ships and men who are our first line is much to be desired. Quite certainly the *Scientific American* can be depended upon by reason of its long and valued career to present the United States Navy to the American reader in its proper light technically and tactically.

In the congratulations which Army Ordnance extends to a venerable contemporary nearly six times as old as itself there is woven the very sincere appreciation of the fine work the *Scientific American* has done for our national defense these many years. A pioneer in the realms of thought and investigation which have led to so many of our peace-time engineering achievements, this technical journal has a way about it which many lay readers would do well to note particularly. The note is one of stability in the field of military science. Far, far too many allegedly scientific magazines have a leaning to the spectacular. Some tenth rate writer somewhere for want of copy, having seized upon a grotesque idea about a new defense development—generally existing in the fertile brain of nobody—starts a chain of equally grotesque ideas that years of denial cannot live down. Not so the *Scientific American*. For ninety years it has kept its feet on the ground while treading the paths of military progress, its head high, its eye alert, its good sense always functioning and encouraging national defense advancement. Its Navy number in November will be the latest evidence of this policy. To Mr. Orson D. Munn, its editor and publisher, and to Mr. F. D. McHugh, the general manager, Army Ordnance, because it admires those who do not specialize in the spectacular, extends felicitations to the *Scientific American*, as a great national asset and to its efficient staff defense-minded Americans add their thanks and best wishes.

And while we are about it, a word of very heartfelt commendation to our esteemed contemporary, *United States Naval Institute Proceedings* upon its special number commemorating the ninetieth anniversary of the United States Naval Academy. Truly the October issue of the *Proceedings* is worthy of the great event it celebrates. Always a delight to the eye and a stimulant to the mind, the anniversary number recounts the long and glorious history of the Naval Academy, describes the men who have contributed to its usefulness and narrates the history and traditions of the Academy in its many fields of educational achievement. Commander Anderson and his associate editors have brought this venerable journal to new glories. Our American literature of heroic men and fighting ships has profited greatly through this medium during the past half-century and continues to do so today with undiminished vigor.

The *Proceedings* was founded in 1873 for the advancement of professional, literary and scientific knowledge in the Navy. For over sixty years it has been the Navy's forum covering a wide range of interesting subjects accompanied by beautiful illustrations pertaining to the sea. There is no better way for friends of our Navy to stimulate their regard for our first line of defense than by reading the fascinating pages of the *Proceedings* regularly. The ninetieth anniversary number carries out every Navy tradition.

THIS NEUTRALITY

THE so-called neutrality legislation put into effect during the closing hours of the last session of the Congress is indicative of the hysterical state of mind which prevailed in that body. After a great deal of nonsensical debate the august Senate contented itself by reducing the intricate alternative of peace or war to a matter of guns or no guns. We would have expected a high school debating society to have made a better analysis of the facts involved.

It is quite beside the point of these remarks whether any arms, ammunition and implements of war are ever shipped from the United States to any country on the face of the globe. While we see no reason to penalize the very few concerns in the United States who manufacture completed weapons or parts we see a thousand and one reasons why our law makers do not want to know the basic facts of conflict. All that need be said is that their peaceful motive is entirely laudable but their ways of going about it are entirely laughable. Machievelli is accredited with laying down the rule in matters of statecraft that the end justifies the means. Apparently there are statesmen in the United States who knowingly or unknowingly follow this same kind of statesmanship.

By legislation and proclamation the shipments of arms, ammunition and implements of war is to be controlled and none is to be exported to belligerents. The proclaimed list is that drawn up at Geneva in 1925. It is a fairly good catalog of the things men call armament. But he who believes that wars are made or prevented by traffic in such implements should be willing to believe that the earth is flat; he who thinks conscientiously that neutrality consists in stopping such traffic shows very plainly that he does not know the very elementary facts, the stark realism, of war.

On the proscribed list are guns to be sure. But guns are nothing more than rifled steel tubes of specified characteristics. So there must be some determinable point at which a steel tube becomes a gun. Up to that point under this legislation we are decidedly neutral in sending abroad all that we like. Beyond that point this neutrality is violated. The same holds true for every single item and part on the proclaimed list of arms, ammunition and implements of war. When does an airplane change from a commercial type to a military type? Given an emergency serious enough any passenger ship at the local airport can become, without the slightest modification, a weapon of the highest order. Or again "tanks, military armored vehicles and armored trains" are among the proscribed items. Why not automobile trucks and passenger cars? Surely they have a real military use.

We have scanned the list in vain and we find no common everyday matches! Yes, we mean the garden variety of sulphur or safety match. The legislation is presumably confined to implements of destruction but what is more destructive than a match in the hands of an enthusiast intent upon havoc. With a gross of them a greater conflagration could be started than with a thousand times their weight and a million times their value of guns, airplanes, bombs and shell.

This neutrality is a sham which even its sponsors must realize. Certainly popular comment realizes it and is expressing itself. Only Senators of the United States believe that we are neutral when we tie the hands of the "arms" maker. Probably the political consequences of advocating a neutrality which would prevent shipment of everything in time of war are too great and too obvious. But until we embargo all raw materials, including food-stuffs—as well as finished products by whatever name they are called we are displaying a mentality which does not know the meaning of the very word neutrality and may bring about more quickly the very thing we meant to prevent before we got hysterical. The following editorial comment of the *Washington Post* is a splendid analysis and condemnation of the present legislation:

"This week wheat prices have been advancing by leaps and bounds, cotton has joined the upward movement, and export quotations for copper have also risen. These concerted increases in prices of commodities which are in great demand whenever wars threaten would hardly have been so sudden or so pronounced had it not been for the extremely pessimistic tone of European dispatches.

"To be sure rumors of war are not solely or even primarily responsible for the sharp rise in wheat prices. That is largely due to reports that a devastating drouth has virtually eliminated Argentina as a wheat exporter in coming months.

"Similarly the improved outlook for cotton is partly the result of AAA rulings regarding loans and benefit payments, while a growing demand for copper has been in evidence for some time. Nevertheless, the stronger buying demand for these basic commodities itself requires explanation. It is reasonably certain that preparation for war and speculative buying in anticipation of war have played a large part in the current market upturn. Certainly the war scare accounts for the boom in munitions stocks during the present week.

"Senator Nye and his colleagues who virtually forced the President, against the wishes of the State Department, to sign the 'mandatory' neutrality resolution, ought to be chastened by a study of market behavior. It shows clearly that a mandatory embargo upon all exports of arms, munitions and implements of war to belligerents is not a means of keeping this country free from entanglements.

"Shipments of all sorts of raw materials are as indispensable to the conduct of modern warfare as guns and explosives. Indeed European nations are not as dependent upon the outside world for finished implements of destruction as they are for basic raw materials needed for the provisioning and clothing of the armed forces and the civilian population, and for the domestic manufacture of munitions.

"Consequently a so-called 'neutrality' policy that is content merely to place embargoes upon the export of arms, ammunition or implements of war is a singularly superficial and ineffectual method of trying to aid the cause of world peace. Moreover, the feverish trading in 'war stocks' shows that the public doubts the ability of the Government to prevent the manufacture and sale of arms and munitions to belligerents under the licensing system contemplated by the Pittman resolution. In view of the manifold opportunities for evading an embargo, Congress should have realized that more time and a great deal of money are needed to develop an adequate system of control.

"The extent to which American producers and exporters profit by a war in Europe, or even the prospect of a war, will measure the completeness of our failure to remain aloof from the conflict by simply refusing to sell munitions to the principal combatants. International trade is too complicated and the economic activities of peace and war times are too inextricably intertwined to permit a trading nation to isolate itself from a major world conflict. . . ."

New Weapons in Old Africa

An Editorial

MILITARY students are watching Italo-Ethiopian developments in a light differing somewhat from the general political view. While they share the concern of all public-spirited individuals for the newer methods adopted in the name of peace—the decidedly lopsided American policy of neutrality, the sanctions of the League of Nations, the ultimate sincerity of threatened embargoes and the final alliance of powers on the one side and the other, these realistic students have a well-founded interest also in the military strategy and tactics which are to unfold. Wishing devoutly that the scourge of war might be circumvented for the present belligerents by some righteous and effective means, nevertheless the observer whose leaning is toward the military as such is wondering what this first great conflict seventeen years after the World War will produce in the way of utilizing modern equipment in actual campaign.

Competent observers in their appraisal of possibilities will not be led astray by fabulous claims. A fortnight ago the writer of these lines was among those at a dinner party in upstate New York. The hospitality of the hostess was delightful but quite overshadowed by the great fund of factual data she was sure she possessed regarding the outcome of the African dispute. She was certain that one of the belligerents has huge supplies of a new gas to burn the feet of unshod African natives. Equally certain was she that the same belligerent has thousands of tanks, all amphibians capable of penetrating the rivers, streams and forests of the jungle.

Nor will the sincere student attempt to prophesy as to the exact limitations of the newer forms of military equipment. Prophecy in things military is probably the most dangerous form of the art of foretelling. Battle hangs on the opportunity of the moment, the vision of the commander, the agility of maneuver. Audacity and surprise have more to do with victory or defeat than some of the best laid plans. Nevertheless it is entirely pertinent to ask, before the event, what the present proving ground test will show for post-war equipment. The battlefield after all is the greatest of proving grounds!

TAKING the detached view of the present conflict we can recall that during the last war three highly important new weapons appeared in land warfare. In the order of their importance they were (a) aircraft, (b) armored motor vehicles, (c) gas and smoke. Are the armies of today—our own included—organized and trained to develop anything like the maximum power and effectiveness of these weapons? As we have read the accounts none of them are—unless it be possibly the German army which is decidedly new having been raised and equipped only recently. This being true in theory at least, what results will be obtained from the use of a modern air force in Ethiopia? The speculation becomes quite intriguing. Abyssinia is a country practically without roads, mountainous and seamed with deep gorges. Once the high plateau is reached there is arable land, sometimes watered, sometimes not. The Italians appear to have established air bases in their colonies bordering Ethiopia as they quite naturally would. Hence the pertinent question, what will be the military utilization of aircraft in this situation and how will it operate? We do not refer, of course, to raids having for their purpose the lowering of civilian morale or the chance destruction of some vital facility. Stated in simplest terms, our quandary is probably best put by bringing the situation directly to our own doorstep. For example:

To cross a deep gorge—like the Canyon of the Colorado, for instance—by descending from one side to the bottom and climbing out on the other is liable to be a heart-breaking task. For a column of soldiers loaded down with equipment and supplies it is hard to exaggerate the difficulty. On the other hand the air is open and unobstructed. Let us suppose that a practicable landing field has been found on the other side of the canyon. Can an air force organize an air expedition with troop-carrying planes, bombers, fighting planes, etc., which can capture some landing place on the other side of our canyon, land the troops, protect them while they fortify and furnish them afterward with ammunition and other needed supplies? And the question of supplies is not to be taken lightly. Aircraft without gasoline—and a goodly supply of it—just as guns without ammunition—and a goodly supply of it—are so much dead wood.

The Italian army is reported to have a large well fortified air base at Assab. Similarly there is reported to be a landing field of sorts at Addis Ababa. Could an air expedition based at Assab capture the airport at Addis Ababa, fortify and hold it and be supplied from the air? The distance between the two points is 450 miles more or less.

ARMORED motored vehicles have contributed in immeasurable degree toward the return of mobility to the battlefield. But with them the problem of supply has increased an hundred fold. Motorization has grown apace in armies as it has in civil life, still there are many places in our own country, as highly developed with good roads as it is, where the limitations are severe. "Motorization," according to Arnaldo Cortesi writing of the Italian Army in *The New York Times*, "has proceeded at a great rate. All the artillery is now motorized except the mountain artillery, which remains faithful to the mule. Alpine tractors have been developed that can negotiate the most difficult routes and a six-wheel motor truck has been adopted capable of carrying a load of two guns over the roughest ground." The motor, however, is itself a result of definite conditions of use; it connotes roads of some kind, slopes of not too continuously great degree, and at least a clearing. One great disadvantage the motor will always have when compared with animal transport in rough, isolated regions: the motor cannot graze on the land. Service stations with full tanks are quite indispensable.

Gas and smoke are in the category of new military devices. They differ from aircraft and motorization in one major respect—a great deal of psychological hoakum is attached to them. While the use of gas has been "outlawed" it continues to be the favorite mystery of newspaper writers. What new brews have been simmering in secret laboratories to be released when needed are probably among the most overstated claims of the new warfare. What with wind and

humidity and concentration and surprise and maneuver all thrown in, it would appear that gas, if and when used, will find its greatest potential on a stalemate front where flanks are locked and the break through is all but a forlorn hope. Smoke has its screening uses and may help obscure the movements of both attack and defense.

Writing in *The Army Navy and Air Force Gazette,* Major Paul Murphy, formerly Director of Experiments of the Chemical Defense Experimental Station, Porton, makes these observations: "The use (in Ethiopia) of gas artillery shell, then, is a doubtful proposition; but it cannot be ignored. In large scale battles on the model of the trench and open warfare of 1914-1918, they might give great military advantages to the user. But so far as mountain or guerilla warfare is concerned, it is doubtful whether anything more than moral effects could be looked for, because of the variable and unfavorable meteorological conditions in mountainous regions for the large scale use of gas.

"The use of gas from airplanes on the other hand might give considerable advantages not merely in large scale engagements, but also in dispersed or guerilla warfare. Difficulties of transport are overcome, larger quantities of gas can be used and attacks repeated at frequent intervals. It seems impossible to believe that in the event of a conflict Italy will not secure and keep air dominance, and when the speed and range of airplanes in relation to the area of Abyssinia is considered, it is clear that the possibilities are considerable. If gas is used in any war the case for its aërial employment is overwhelming. How far will mountainous regions limit the use of aircraft is a matter that can only be decided by the military air experts, and on their answer will depend the estimate of the extent to which the aërial use of gas in Abyssinia is likely to be successful. Undoubtedly certain regions will prove impossible. But if a sufficiency of targets can be attacked, then the use of gas might develop on a considerable scale even in guerilla warfare; the harrying power of the aërial gas weapon might well be decisive in the hands of a country which gained complete domination in the air. It must be remembered that the airman can place his gas discharge projectiles in close proximity to the target, and that for this reason adverse weather conditions can be to some extent discounted."

WHAT then are the effects to be anticipated with the new weapons in old Africa? We would not hazard an opinion. We wish that qualified students would—before as well as after the event. Our inclination is to discount a great deal of the very superficial comment on the art of this modern war as the "trained seal" correspondents are serving it in the press. Airplanes have not yet been built to run on air, motors are not known to climb trees; gas, if it be gas, is never a solid. Hence, we are old fashioned enough to think that battle in 1935 A. D. hinges as it did in 1935 B. C. on more elementary factors than mere mechanical contrivances. Action today is quicker, of course; ranges are extended, rate of fire is multiplied but these are artificial changes sufficient to turn the day at times but, in the main, mere variations of the old fundamental and essential factors. How greatly weapons are influencing tactics is a problem that only actual and somewhat prolonged trial will solve.

Taking this view we believe that other elements of warfare are being overlooked today in our mad search for preventing conflict. Men—not things—make war; the ingenuity of man using every means he has at hand from what nature and his own resourcefulness have furnished him will bring victory or defeat. Popular discussion today places exclusive emphasis on arms as if the imposition or lifting of an embargo settles the case. The equipment is important, of course, but of equal importance is the human agent who must use it. He cannot make the machine do the impossible. Upon the development of his skill will depend the successful use or the dire failure of his weapons. So that leadership, discipline, training and the service of supply will determine tactics which in turn will influence strategy which in turn will win or lose campaigns. Mountains will not be moved, rivers will not be diverted, roads will not be emplaced in a day. Battle wherever fought will come back as it always has to those two essentials, men and their arms. Men must be trained, leaders must know the ramifications of strategy and tactics, reserves must be available and the limitations of the human machine under given conditions must be considered. Munitions—the inanimate member of the 3 Ms (men, money and munitions) must be available in quantity and kind, supply must be worked out to high perfection. As to the performance of men and munitions in the present case, military students will watch with a discerning eye. They will not share the opinion of the novice that generalship is a minor factor or that arms and ammunition, in themselves, mean victory. Aircraft, motorization, gas and smoke—the cutlass, the camel corps and the mountain fastness—are factors that the trained strategist will use to good purpose as occasion demands. Victory will rest—as it always has—with the side, which having both its trained men and its serviceable weapons in sufficient quantity, puts them to best use. But mere newness of media will not, in our humble opinion, change the nature of warfare in old Africa. A man standing on his feet capable of exacting compliance by rifle and bayonet is still the final arbiter when force is resorted to. The new equipment may hasten the achievement but it will not do one whit more than that.

YET military science is to be observed and studied as much in the making as in the made. The social and economic no less than the military forces at work must be analyzed while they are in process—the military especially. As concepts are changing it is far more advantageous to appraise them in the present than to weigh them in the embalmed past. For this very weighty reason, apostles of mechanization and motorization do well to observe the uses to which the new military equipment is assigned and the performance it is capable of bringing to its task. They will readily agree that the inexorableness of the nature of conflict is unchanging but they will likewise concede that the testing ground of actual battle is the crucible wherein the new modifications meet actuality. Entirely aside from the merits of the present conflict, old Africa is furnishing the traditional and quite reliable gauge of warfare in transition and military science would be the better if experts were in a position to comment upon the practicality and feasibility of the new tactics. The fact will always remain that machines cannot do the impossible and that battle—as distinguished from slaughter—and tactics—as distinguished from brute slaying of noncombatants—still turn on generalship whether in old or new fields, with or without modern equipment. It was ever thus.

Ordnance Field Service

ORDNANCE ACTIVITIES IN THE ZONE OF THE INTERIOR
PART II

By MAJOR RAYMOND MARSH, *Ord. Dept., U. S. Army*

IT is essential that the quantity of items in storage at any particular depot be held at desirable levels. This is effected by means of what is known as the Ordnance Provision System. The use of the word "provision" in this connection is unfortunate in that it has a different meaning when so used than it does when applied to the acquisition of supplies. Any large business activity with a central office and smaller branches, whether it be a civilian organization or a governmental department, if it has the problem of manufacture and distribution to meet the requirements of a seasonal or varying market, must know by some method certain essential facts, either at stated intervals or on demand. It must know, first, the stock in the hands of branches or dealers at the time of reporting. This item of information in military parlance is known as stocks "on hand." Next, it is desirable to know the amount of orders filled by the branches or dealers since the date of the last report, or over a given period of time. In military parlance this is known as "issues." Next, it is necessary to know what shipments have been promised by the central manufacturing agencies to the branches or dealers at the date of the report. In military parlance this is known as "dues in." It is next necessary to know the amount of unfilled orders on the books of the branches or dealers at the time of the report. In military parlance this is known as "dues out." Then the central office must know the requests from the branches or dealers. In military parlance this is known as "demands." From this collection of data the central office is enabled to determine probable requirements and, therefore, production for the next basic period, and also to arrange, if necessary, a redistribution of stocks in the hands of its several branches when expected demands on one have been, or will become, beyond its capacity, due to a change of conditions. The internal system in use within the Ordnance Department by which all Ordnance establishments are provided with the necessary stocks of ordnance, and which furnishes the necessary information as to the status of such supplies to the central office for the purpose of replenishment, either by transfer or procurement, is known as the Ordnance Provision System. The Ordnance Provision System operates only between the Office of the Chief of Ordnance and establishments or sections thereof, under the control of the Chief of Ordnance, which contain Ordnance supplies for storage and issue to the Army. Ordnance depots under control of other commanding offices,—for example, area, department, or station depots,—replenish their stocks by submitting requisitions in the same manner as organizations.

The Ordnance Provision System provides for periodic reports from supply establishments to the central office. These reports show the supplies on hand, issues covering a definite period, obligations or unfilled requisitions, anticipated receipts from all sources, and finally, demands for replenishment of stocks. This system operates through the use, primarily, of four forms. I will not attempt to describe in detail these forms or the mechanical methods by which these forms are handled. I will merely describe very briefly their use. The first of these forms is known as "stores report sheet." As part of the Ordnance Catalogue, there is published what is known as "schedule of stores report," previously known as "schedule of review." These schedules of stores reports cover all the groups of Ordnance matériel, and the schedule of dates for their submission covers the entire year, so as to distribute the work involved therein as evenly as possible throughout the year. These schedules are revised from time to time as conditions may require. Upon the date called for the submission of the stores report, it is filled in so as to show the quantities on hand, the quantities issued since the date of the last report, the amount of dues in, the amount of dues out, and the demands or requirements of the establishment submitting the report. These demands or requirements are based on the maximum quantity of such items which the establishment is authorized to have on hand. The depot commander abstracts these five figures from this report onto a document known as an "abstract of stores report." This abstract is retained at the establishment for its own use.

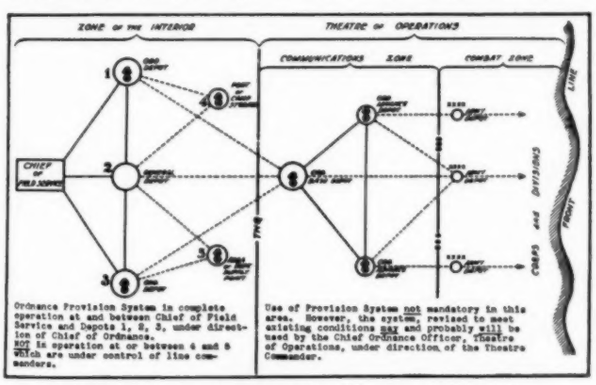
THE stores report itself is forwarded to Washington where in the General Supply Division of the Field Service Group of the Office of the Chief of Ordnance, the figures shown on these cards, from all establishments, covering any particular item, are transferred and consolidated on a third form, known as a "consolidated stores report." Based upon a consideration of the information shown on this consolidated report, the Chief of Field Service issues the necessary transfer orders to effect the desired shipments from one establishment to another, provided such supplies are available in excess at any of the other establishments under the control of the Chief of Ordnance. When supplies are needed by a depot and such supplies must be manufactured or otherwise procured, then a requisition in the quantity desired is submitted to the Manufacturing Service and the supplies, when completed are shipped to the several supply depots on a shipping order.

At the present time, this system is operated almost automatically through the medium of Elliott-Fisher machines. These machines reduce the work to a minimum and insure a high degree of accuracy, because of the fact that the current property records of transactions are transmitted by means of carbon copies from the stock record cards to the stores report sheet. Consequently, special reports may be called for at any time with no more work than that involved in pulling out one carbon copy and inserting a new blank form in its place. In time of war, it may be necessary to have reports made on certain important items by telephone or by telegraph, at certain indicated periods of time. With the future development of the telephone-typewriter system, it is possible that this method will supplant other methods of communication and submission of reports. It can be seen from a survey of the operation of this system that it enables the central office of record to maintain complete records of the status of items, with respect both to the United States as a whole, and to each individual depot. Thus, where one depot shows a deficit or an expected deficit in a certain item, it can readily be determined by referring to these consolidated records, whether a surplus can be transferred from some other depot to fill this deficit, or whether it will be necessary to initiate procurement. This close central control of stocks eliminates the possibility of the purchase or manufacture of supplies of which there is a shortage at one place, while a surplus of the same item exists at some other point.

It is important to note that this system is mandatory in its operation only to those establishments under the control of the

Chief of Ordnance. This applies, therefore, only to Ordnance installations in the Zone of the Interior. However, this fact does not prevent the application of the same system or some similar system to the supply organizations in the Theater of Operations. The limitation upon the mandatory application of this system is evident when it is realized that a supply branch cannot dictate to line commanders how their supplies shall be handled, reported, and otherwise checked. It is a fact, however, that this Ordnance Provision System had its origin during the World War in the Theater of Operations, and the very reason for its creation and existence was to facilitate war supply organization. Wherever any such system can be used to advantage, it will undoubtedly be put into operation by the proper staff officer on the staff of the commanding officer.

SO much for the Ordnance Provision System, by means of which proper distribution of stocks and the maintenance of the proper level of supplies in each Ordnance Depot, is assured. In addition to this system, there is also a system of property accounting. This method of accounting for property is universally the same for all supply departments and military organizations of the Army, and is covered very fully in Army Regulations. The property accounting system is based on three fundamental principles—first, all transactions in a property account must be supported by competent and complete written evidence, called vouchers—second, someone must be accountable and responsible for all property at all times and places, except in combat zones during a war—and third, reasonable care must be used to prevent loss, destruction, and unserviceability not due to fair wear and tear in


ZONE OF THE INTERIOR
THEATRE OF OPERATIONS
COMMUNICATIONS ZONE
COMBAT ZONE
CHIEF OF FIELD SERVICE
Ordnance Provision System in complete operation at and between Chief of Field Service and Depots 1, 2, 3, under direction of Chief of Ordnance.
NOT in operation at or between 4 and 5 which are under control of line commanders.
Use of Provision System not mandatory in this area. However, the system, revised to meet existing conditions may and probably will be used by the Chief Ordnance Officer, theatre of Operations, under direction of the Theatre Commander.

OPERATION OF THE ORDNANCE PROVISION SYSTEM

the public service. The property accounting methods and the Ordnance Provision System are entirely different and serve different purposes. However, in an Ordnance depot they have points of contact. In some instances, the same data are required for the two systems and are placed on the proper forms and the two functions performed simultaneously, by the same personnel. The basic form of the property accounting system is the stock record card. By means of the Elliott-Fisher machine system now in operation at Ordnance depots, the entries for an item on the stock record card, the stores report form, and the shipping ticket or receiving report, are made simultaneously. It must be remembered, however, that this machine system is merely a labor saving device and in no way affects the principles of either the Provision System or the property accounting system. The entry on the stock record card is the meeting place of these two systems. Property accounting begins with the entry on the stock record card, and the subsequent entries thereon either from shipping tickets or receiving reports, give the life history of the item from the time of receipt until it is dropped from the stock record card on the authority of a proper voucher. The entries on the stock record card, as transferred to the stores report card, constitute the basic data for the operation of the Provision System. From this it will be noted that the stores report is made directly from the stock record card. Consequently, it gives the details of all transactions with respect to that item since the last report. It is important to bear in mind the existence of these two systems and the two entirely different purposes which they serve, despite their common meeting ground.

THE next subject to be discussed is that of issue. In time of peace, issues are ordinarily made direct to posts, camps and stations on requisitions, all correspondence in connection therewith being handled through the appropriate military channel of supply. This includes shipments to foreign possessions as well as to Army posts within the continental limits of the United States. In time of war, issues may be made in the same manner on requisitions. It is very probable, however, that the bulk of issues, particularly those involved with the initial equipment of newly mobilized forces, will be made through the medium of what are known as "credits." A credit is simply an allocation of a definite quantity of supplies, placed at the disposal of some commanding officer for a definite period of time. Supplies which are covered by such a credit are available on the demand of the commanding officer involved, and are shipped at his request to such places and in such quantities as he indicates. This system of establishing credits applies not only to the Zone of Interior but it is also widely used in the Theater of Operations. From the Zone of Interior to the Theater of Operations, shipments may be made on the basis of requisitions or credits, but more commonly they will probably be made through a schedule of shipments, or in accordance with prearranged priorities.

The supplies being issued and coming into the possession of military organizations for use, the question of maintenance becomes of more importance than the maintenance of the same item when in storage. Maintenance is properly a function of supply, in that it replaces through the medium of repairs, an unserviceable item without burdening the channels of supply by requiring a complete replacement of the unserviceable item from some of the echelons of supply. In the Zone of Interior, the maintenance obligations of the Ordnance Department are discharged through the media of Ordnance maintenance companies, post Ordnance detachments, civilian employees of one class or another, and the facilities pertaining either to the Ordnance maintenance companies or the permanent post shop installations pertaining to the Ordnance Department. Mention must be made of the activities of the Corps Area Ordnance Officers and such personnel as are assigned to them for maintenance purposes. This personnel constitutes, in all respects, small mobile maintenance units, and they operate temporarily, but at more or less regular intervals of time, at posts, camps and stations where no Ordnance personnel is regularly assigned.

At the same time, the Ordnance Department must discharge its obligations of inspection. Inspections in time of peace are prescribed to be conducted within certain intervals. In time of war probably a more or less similar schedule will be followed. Inspections are conducted not solely for the purpose of determining what is wrong with the matériel, but also for the purpose of determining whether or not proper maintenance methods are being followed by the organization to which the matériel is issued. As a result of such inspections, a great amount of Ordnance matériel is turned in to the proper authorities for repair, or other appropriate disposition. Inspection, however, is not the only means by which Ordnance property is turned in for repair or final disposition. It is also turned in by the organization involved upon that

organization's own determination as to whether or not the article is in need of repair, or has become unserviceable.

Mention must be made of the fact that inspection and maintenance functions performed by personnel pertaining to military organizations, tactical commands and military areas are under the control of the military commanding officers thereof. In these cases the authority of the Chief of Ordnance is limited to technical supervision and control.

The Ordnance Department operates its supply system on the basis of exchangeability. That is to say, no matter what might be the type of item, if it is unserviceable through fair wear and tear, it will be exchanged for a serviceable item without any paper transaction or any work other than bringing it to the appropriate Ordnance storehouse and presenting it for exchange. This system of exchangeability is wholly practicable with respect to the Regular Army in time of peace where exchange facilities, chiefly in the form of warehouses, exist at practically all regular Army posts, camps, and stations. In the National Guard this system is not wholly applicable, first, because such exchange facilities do not always exist, and second, because of the fact that the supply of the National Guard is based entirely upon finances, and no item, no matter how badly it may be needed, is procured or issued to the National Guard unless sufficient funds are available and at the disposal of the National Guard Bureau for the reimbursement of that item. When an item is unserviceable through other than fair wear and tear, the responsibility for such condition must be determined by what is known as a "report of survey." Unserviceable property, whether it is covered by such a report of survey or whether it has been received through the medium of exchange, is finally disposed of on the authority of what is known as an "inventory and inspection report," which is accomplished on the authority of officers pertaining to the Inspector General's Department or such officers as may be especially detailed to act as Inspectors General at posts, camps and stations for certain classes of matériel. Property carried on an inventory and inspection report, is disposed of by being destroyed or by being turned in to salvage, where it is sold as scrap after its serviceable components have been removed. This completes the life history of an item of supply and as far as any property accounting system is concerned, the item no longer exists.

No account of Ordnance activities in the Zone of the Interior is complete without a recital of the activities of the Aberdeen Proving Ground. This Ordnance establishment is involved primarily in the test and development of experimental items. In addition, however, it performs such important functions as tests for acceptance, ammunition performance tests, experimental firings, and the collection and calculation of data necessary for the compilation of range tables, firing charts, etc. One of its most important functions in time of peace is the conducting of performance tests of ammunition in war reserve.

INCIDENT to all the functions which we have described above, the Ordnance Department must issue certain publications, and this constitutes a big task in itself. As we have indicated, the Ordnance Department publishes the Ordnance Catalogue in the form of Standard Nomenclature Lists. We have also indicated that modifications are effected on matériel and other items of Ordnance supply on the authority of Field Service Modification Work Orders. The Ordnance Department also publishes a system of Ordnance Field Service Bulletins which contain special information as to the care, storage, issue, repair, sale, etc., of Ordnance supplies, including ammunition as well as general supplies. These service bulletins are valuable sources of information and any officer assigned to an Ordnance Field Service assignment should avail himself of the information contained therein. The Ordnance Department is also responsible for the preparation, publication, and distribution of all firing tables, trajectory charts and other fire-control data for all armament which it produces. The data on which these fire control documents are based is collected largely at the Aberdeen Proving Ground. Technical Regulations covering all items of Ordnance supply are prepared in the Ordnance Office, and published by the Adjutant General. The same applies to Training Regulations with respect to Ordnance troops. There are also a number of miscellaneous documents, pamphlets, etc., which are produced and published by the Ordnance Department as the occasion may arise, as for example, the Ordnance Safety Manual and the present tentative edition of the Ordnance Field Manual. Field Service Circulars for distribution throughout Field Service agencies are also prepared by the Ordnance Department.

Another important function of the Ordnance Department not mentioned in any of the categorical functions previously described is that of the operation of the Ordnance technical schools. In time of peace, these consist of but two. The Ordnance School for Commissioned Officers extends through a two year's course and is conducted at Watertown Arsenal and at the Aberdeen Proving Ground. The first year's course is conducted nominally at Watertown Arsenal but largely at the Massachusetts Institute of Technology. This first year's course includes not only technical instruction but also practical shop operation. The second year's course includes visits to certain Ordnance establishments, studies in Field Service problems and contacts with activities being conducted at the Aberdeen Proving Ground, which afford the students a splendid opportunity to become acquainted with the latest types of equipment and with the several kinds of research and development being conducted by the Department. The second school is the Ordnance Field Service School, located at Raritan Arsenal, Metuchen, N. J. This school is primarily for the purpose of training such specialists as are needed in Ordnance services. These specialists range all the way from welders to stenographers. At the present time, the school conducts the so-called Enlisted Specialists' Courses for a group of approximately 50 enlisted men of whom more than half are members of arms and services other than the Ordnance Department. Their course lasts through one school year, approximately nine months. They also conduct a class qualifying men for promotion to and assignment as post Ordnance sergeants. This course includes instruction in maintenance, administration, depot and supply functions and ammunition. Whenever the occasion arises, the Ordnance Field Service School conducts special courses for officers or enlisted men, emphasizing such special features of Ordnance activities as may be required. The keynote of the Ordnance Field Service School is the high degree of practical instruction which is conducted there. *(This series of articles by Major Marsh describing the functions of Ordnance Field Service will be continued in the November-December issue of this Journal.)*

The Index to ARMY ORDNANCE, Vol. XV, which concluded with the May-June, 1935, issue, is now ready for distribution. Copies, with title page for binding, will be furnished, without charge, upon application to

The Editorial Offices,
ARMY ORDNANCE ASSOCIATION
Mills Building, Pennsylvania Ave. at 17th St.,
Washington, D. C.

Book Reviews

GLORY HUNTER—A LIFE OF GENERAL CUSTER. By Frederic F. Van DeWater. Indianapolis: The Bobbs-Merrill Co. 1934.

IN the opening chapter of this book, Mr. Van DeWater describes the character of General Custer as follows:

"He followed Glory all his days. He was her lifelong devotee. She gave him favor withheld from most men, and denied herself when his need of her was sorest.

"He followed Glory to his doom. Thereafter, woman-like, she followed him. The paradox is consonant with the career of George Armstrong Custer. He himself was paradox; the word made flesh.

"Few men have been more vehemently positive in character. None has thwarted generalization with more baffling contradictions.

"He was a popular hero who was scorned by many in his own profession.

"He was the idol of a few subordinates and distrusted by others.

"He was a tenderly devoted son and husband and a brutal commander.

"He was gentle with his dogs and horses, yet blind to suffering he inflicted on men.

"He was a dangerously insubordinate officer; he had been a most slovenly cadet and subaltern, but he enforced discipline on his own troops inplacably.

"He has been praised as a knightly and gallant foe; he had been decried as butcher and lyncher.

"He was renowned for his flaming valor in battle, yet his record is marred by one stain, that is the blood of Major Joel H. Elliot and nineteen men, killed by what was at best, the incredible callousness of George Armstrong Custer.

"He is best remembered as the foremost Indian fighter of his day but his only positive victory against the red men was massacre rather than conflict, and his chief surviving fame as a soldier is based upon a defeat as complete as ever United States regulars sustained."

The author then devotes the bulk of the book to proving that George Armstrong Custer's every act was a play to the gallery, that he was a poseur, that everything unfavorable was true, that anything favorable was true only because some one else was responsible for it and every act in Custer's career was based on a coldly selfish calculation as to the notoriety, publicity, fame and benefit it would bring him. Custer's character may have been the paradox that is depicted; maybe he was responsible for all his bad features; maybe his good features existed in spite of himself and because of persons and powers beyond his control. Nevertheless, of the three officers mentioned—Benteen, Godfrey, and Varnum—who knew him and served under him, two were devoted to him. And the gentle scholarly Morris Schaff, in his memorable book "The Spirit of Old West Point," says of Custer: "the light-hearted and gallant fellow, I cannot mention his name without swimming eyes." Custer was a member of the Class of 1861, U. S. M. A.; Schaff belonged to the Class of 1862. Perhaps Schaff's evaluation of Custer, the opinion of a contemporary, is more accurate than that of a researching historian some sixty years after his subject's death. No one claims that Custer was a yellow-haired god. But it does not necessarily follow that he must therefore have been "a stuffed shirt."

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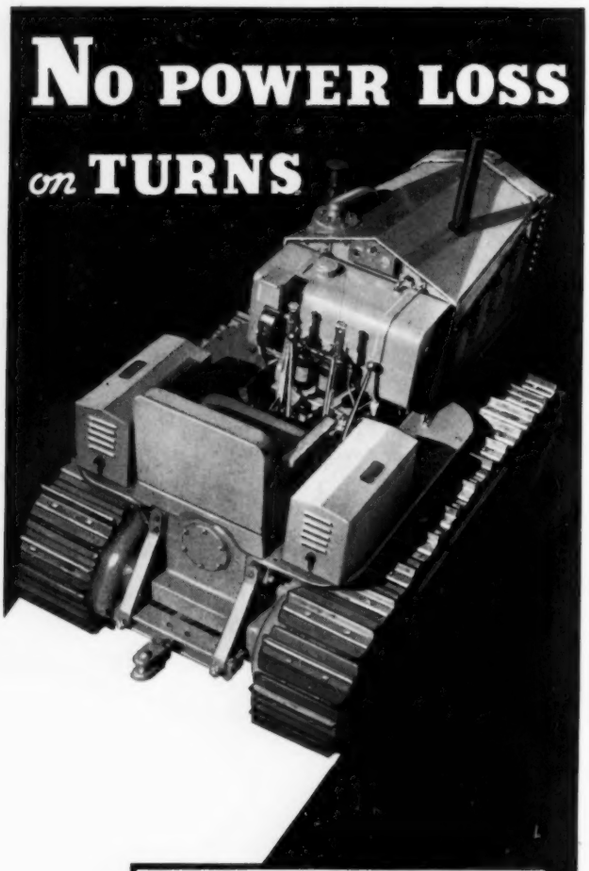

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Historically, the accounts are not always accurate, some of the conclusions reached are highly original and not supported by better authorities; and some are contradictory. Thus, of the affair at Trevillian Station, on one page the author says, "Who was blameworthy, none today can tell." In another place he says, "At Trevillian Station, his rashness got him caught between two Confederate commands." Sheridan's account of this fight, in his Memoirs, paints an entirely different picture.

Again, at Gettysburg, Custer is portrayed as having disobeyed orders and of having charged, at the head of one small troop of cavalry, the whole of Wade Hampton's division. As to the alleged disobedience of orders, Custer received two conflicting orders—he obeyed the last of the two. Who would have done otherwise? And as to this alleged foolhardy charge, the accounts by competent, recognized military critics are entirely different.

And so it goes. Custer is damned when he does and damned when he doesn't. It is conceded that he died gallantly, but likewise it is inferred that as Shakespeare phrased it, "nothing in his life became him as the leaving of it."

Nevertheless, this is an interesting book and, if one is sufficiently well acquainted with the military history of the period to detect the liberties which have been taken in the present version of those events, it adequately depicts the less likeable phases of Custer's personality and characteristics and portrays vividly the criticisms that are bound to be hurled at some one who stands out in a crowd. R. M.

Le 3e Corps d'Armée de Charleroi à la Marne. Essai de Psychologie Militaire. By General Gabriel Rouquerol. Paris: Berger-Levrault. 1934. Fr. 15.

La Défense du Couronné de la Seille. By Ch. Rolin. Paris: Berger-Levrault. 1934. Fr. 12.

TWO studies of the detailed tactical operations of a French Corps and a Division in 1914 have recently been added to the series of monographs published in France on the World War. General Rouquerol, who commanded the artillery of the 3d Corps, describes in his book the retreat of this Corps from Charleroi to the Marne and its participation in that battle. The great value of this book to the military student is its subtle analysis of the psychology of the leaders and troops in this retreat. It is a masterpiece of military literature by an artilleryman who had already made his name famous by reason of his studies of the use of artillery during the World War.

Far to the east during this month of August, 1914, the 59th Reserve Division of the French army was posted some kilometers north of Nancy along the Seille with its center at Nomeny. The heroic defense of this division against a vastly superior German force gives Abbé Rolin an opportunity which he uses with the greatest skill to describe the tactical operations of a division in defense. The author continues the detailed story of the defense of the Grand Couronné in this particular region by a graphic description of the fighting in September, 1914, in the vicinity of Loisy and in February 1915, near Xon. D. A.

All's Fair. By Capt. Henry Landau. New York: G. P. Putnam's Sons. 1934.

THE sub-title of this book is "The Story of the British Secret Service Behind the German Lines." This leads the reader to believe that here is a recital of the usual type of spy story—intimately personal, full of glamor, replete with hair's breadth escape, brimming over with romance and with at least one thrill on every page. A reader with this idea is sure to be disappointed. To the contrary, this book is a fascinating account of organized military intelligence. It covers a phase of military intelligence which, to the uninitiated, may seem far removed from the conventional work of a spy. It covers the organization and operation of a comprehensive system of military intelligence that blanketed

the greater part of the German occupied sections of Belgium and northern France for the primary purpose of watching train movements.

As the author himself states, "I myself in other times would never have pictured secret service as an organization devoted to, or even interested in, noting the arrivals and departures of railway units; yet this became a ruling interest of all our lives. The use of the trains by the Germans meant the movement of German troops, and the movement of troops often presaged a mass attack. On our information often depended the Allies' hope of preparing to defend a position, or to surprise an attacking force. The Germans never did have enough troops to initiate an offensive on both fronts at the same time, and so each offensive was always preceded by a large transfer of troops from one front to the other."

Under Captain Landau's guidance, a train-watching system was built up which covered every strategic line in Belgium and northeastern France and which in the last two years of war utilized over two thousand agents. Movements in the front lines were checked by raids, interrogation of prisoners, seized letters, documents, etc., but back of the front it was chiefly on careful train watches that the High Command depended for its information.

All the information which this train-watching organization gathered was not limited just to train movements and neither did it gather all its information from train watching posts. Consequently, there are chapters devoted to the interrogation of deserters, the efforts exerted to obtain post office lists, the dropping of a spy in hostile territory from an airplane, the feat of getting through the high voltage fence along the Dutch border, counter-espionage activities and the observations of Zeebrugge and the Scheldt. The activities of Edith Cavell and her execution by the Germans are related from a different viewpoint. D. H.

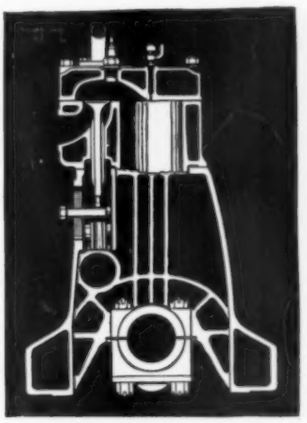
MEN AND SHIPS OF STEEL. By Wayne Francis Palmer with Hanson W. Baldwin. New York: William Morrow & Co. 1935.

IN the foreword to this book, the Secretary of the Navy says, "I have always felt that too much emphasis has been placed by histories and fiction on the relatively small periods during which our Navy has been engaged in war. Therefore, I appreciate that, in the editing of this work, the year in and year out duty of the Navy has been shown in true proportion." The Secretary further says that it is "a most happy circumstance that it has been decided to tell the story of our sea forces in pictures. This work should initiate those living inland, and not privileged to visit our men-of-war, into the complexities of the modern ship, the service routine and the day by day life of our sailors and marines."

The book does just that. The two hundred and seventy-five pictures that make up the volume were selected from more than sixty thousand Navy pictures from all the principal sources of such "shots"—official naval records, the Bureau of Aeronautics, the Office of Naval Intelligence, U. S. Marine Corps, Naval Recruiting Bureau, the Bureau of Construction and Repair, U. S. Coast Guard, U. S. N. A., "Lucky Bag" records, individuals, Fox Films, Wide World Photos, Inc., Harris & Ewing. Naturally, from such a variety of sources, some truly remarkable pictures are presented. The book is divided into sections, following the natural sequence of life, with the appropriate headings of "Heritage," "Birth," "Life," and "Death," and then to symbolize the immortality of the fleet, after "Death" comes a section entitled "The Fleet Steams On." Each section is preceded by a brief historical pageant which shows—by contrast—not only naval evolution since the earliest days of our naval service but also traces to some small extent our naval tradition.

The first group—"Heritage"—shows the CONSTITUTION, the bewhiskered sailors of the Civil War days, a comparison of the CONSTITUTION'S carronades and the CALIFORNIA'S 14-inch rifles,

STRONG AND DEEP



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In the next section it is plainly brought out that the birth of a fleet is no sudden miracle in blood and steel. The career of the midshipman at the U. S. Naval Academy is pictured. And so is the training of the bluejacket and the leatherneck and the Coast Guard. From splendid pictures and their descriptive titles we learn that, as the authors so vividly phrase it," . . . . a ship of steel is a creature formed during long days and nights of travail, whose birth pangs are the sputtering hiss of welding torches and the crashing symphony of steel."

The section covering "Life" shows all phases of the Navy in action—subs, cruisers, full fledged "battle wagons," airplanes and airships. The life at sea is covered by a collection of pictures of a city at sea, ranging from a soda water fountain on shipboard to a blacksmith shop, likewise afloat. That we may realize that the Navy sees the world as it serves, there are pictures of the Canal, Hawaii, the hula, grass skirts, poi, and all the other elements of the conventional tropical idyll.

The next section is devoted to depicting the end that inevitably comes to all. "The path of glory leads but to the grave," and ships travel that path as well as mortals. So, as far as ships are concerned, the pictures range from destruction by torpedoes to destruction by scrapping as the result of so-called limitation of armaments treaties.

But as ships sink, other ships replace them; seamen sail on into the Valhalla of sturdy souls, but the fleet steams on. Frigates have become cruisers and the battleship of tomorrow is being developed today. And the last section of this stirring collection of pictures shows these ships of today steaming on, in review, buffetted by gales, shrouded in smoke, or at anchor under the glamor of a tropical moon.

Yes, this book lives up to the suggestions made by Mr. Swanson in his foreword. And for anyone, no matter what might be his interest, this book holds information, interest and surprising and unusual beauty. R. M.

THE NEW INTERNATIONAL YEAR BOOK; A Compendium of the World's Progress for the Year 1934. New York: Funk & Wagnalls Company. 1935. $6.25.

A PLEASING thing about the recurring issues of the New International Year Book is the general impression a reader always receives of freedom from bias in recording the annual activities in human affairs. For this Dr. Frank H. Vizetelly, who is famed as managing editor of the New Standard Dictionary series, deserves all praise. Similarly his predecessor in this work, Maj. Herbert T. Wade, formerly of the Ordnance Department, United States Army, achieved notable success.

It must be apparent to all thinking people that the volume and distorted presentation of the day's news requires some sober catalog where it may be briefed and factually evaluated. The headlines of yesterday are forgotten today. In some respects it is a good thing that this is so; in many ways it is to be regretted that the popular memory is so short-lived. Nevertheless few people today do not experience the need of a compendium of the more important events of the past year. This need constantly grows rather than diminishes. The New International Year Book serves a most useful purpose in presenting a fair summary of the factual record.

As in former issues, the article in the Year Book on military progress is from the pen of Brig. Gen. John J. Bradley, U. S. Army, Retired. General Bradley gives a bird's-eye view of the military situation on the world front and later recounts the leading developments tactically and technically of the principal countries. The following paragraph accurately summarizes one phase of General Bradley's narrative:

"According to the Chief of Staff, the army's tanks are hopelessly out of date, hundreds dating from the World War, with

only 12 modern ones on hand. Of the latter, only one is of the most efficient type. This one, however, has shown swiftness, ability to traverse any kind of terrain and has deadly fire power. It weighs 8 tons, capable of running either on wheels or laying its own track, has great flexibility of control and easy riding qualities. It is protected with ¾ in. armor, armed with two .30 calibre and one .50 calibre machine guns, and Thompson submachine guns. A crew of four operated the vehicle which is equipped with a radio having an 80-mile range. During the run from Rock Island to Washington, D. C., all existing records were broken for non-convertible, track-laying vehicles. The entire trip of 900 miles, including passage through cities, was made in three days at an average speed of 30 m. p. h."

We concur in the estimate of the publishers of this volume that "the editors have provided in a single volume a greater wealth of information regarding the past year than is to be found in any other work of like scope or purpose published."

O. E. D.

GOVERNEUR MORRIS. By Daniel Walther. New York: Funk & Wagnalls Co. 1934.

THE jacket of this fascinating appraisal of one of the public men of the Revolutionary period carries this thumb nail sketch of Governeur Morris: ". . . the strangest paradox of early American history. Frankly aristocratic in his sympathies, contemptuous of the masses, insolent to his equals, he moved tranquilly through two revolutions, elegant in spite of his wooden leg, epigrammatic, adored by the women of two continents for his gallantry and gay humor, admired and feared by his compatriots for his caustic wit." It would be hard to epitomize more accurately the career of this unusual character.

Born in January, 1752, in what is now a part of New York City, Morris graduated from Kings College, now Columbia University, in 1768. He was duly admitted to the New York bar and began the practice of law in New York City. The political upheavals of that period threw him into public life, for which he had the desirable aristocratic, social and wealthy connections. He was a member of the New York Provincial Congress from 1775 to 1777; of the state constitutional convention, 1776; of the state assembly, 1777-78; of the Continental Congress, 1777-78; and assistant minister of finance, 1781-85. He was a member of the Philadelphia convention of 1787, which framed the Federal Constitution. James Madison, who listened attentively to all the speeches and made brief and luminous resumés, accredits the arrangement and literary style of that Constitution to Morris. From 1788, for some ten years, Morris lived in Europe, frequently serving in some official capacity for his country. He was appointed U. S. Minister to France in 1792 and was the only representative of a foreign country to remain at his post throughout the Reign of Terror. However, his aristocratic tendencies and his unconcealed hostility to the Revolution led the French Government to ask his recall. After some four years more, spent in traveling about Europe, he returned to the United States, took up his residence at the Morris ancestral home in New York, re-entered politics and became a United States Senator in 1800. His last public service was as chairman of the New York Board of Canal Commissioners, which prepared the plans for the Erie Canal. He died in November, 1816.

Morris was a keen observer of events, a sharp analyst of character, an intimate of the outstanding men of two continents and possessed of a pithy but voluminous pen. His comments on some of the characters and events of his day are worth noting. "It was almost as vain to expect permanency from a democracy, as to construct a palace on the surface of the sea," he wrote after the democratic form of a constitution had been abandoned. Madame de Stael he described as "a woman of sense and somewhat masculine in her character; but has very much the appear-

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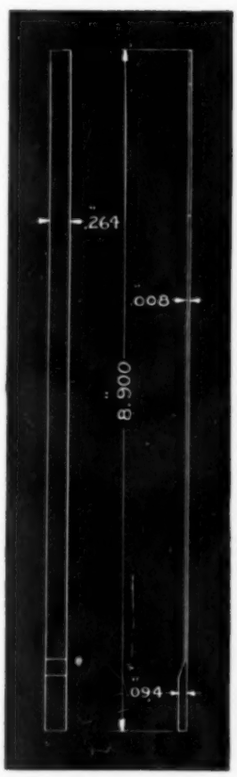

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ance of a chambermaid." Of one of the outstanding figures of the Revolution, Morris said—"He is a vase in which has been thrown all the filth of the Revolution." La Fayette had "the appetite of the devil for glory." Of Mirabeau, Morris said "So dissolute a man would dishonor any administration. One should never trust a man who has so few principles." Talleyrand was distinguished by "complete amorality, an indifference to the methods which can bring about success, indifferent between vice and virtue." Napoleon, he considered, "lacked courage but was clever at hiding his cowardice."

There is no question but that Morris contributed mightily to the well being of this country in the infancy of its independence. Any one who wishes to know the history of this period as a Macauley would have portrayed it, should read the life and writings of Governeur Morris as Dr. Walther has sifted, analyzed, weighed, compared and presented them. R. M.

AIDS TO HISTORICAL RESEARCH. By John M. Vincent. New York: D. Appleton-Century Co., Inc. 1934.

THE evaluation of historical data of all kinds has been put on a solid, scientific basis in the past few decades. The principles are clearly established in this little book by Professor Vincent which is designed to aid the beginners in historical research. The change in the conception of history through the ages is apparent from considering the subjects deemed noteworthy by Herodotus and Thuycidides, by Froissart, by Macaulay and by other historians in recent generations.

But admitting a sound decision concerning the contents of an adequate history of a race or a nation, how is historical material tested, how should documents be used, what should be the attitude toward the manuscripts that preceded the printing press? The student of history must have a clear idea of ancient weights and moneys, of the system of dates that went out of fashion with the lapse of time, of the influence of geography on history. Professor Vincent has successfully clarified all these points in the background of history in a simple, non-technical style that is readily comprehensible to the layman. D. A.

SPANGLED BANNER. By Victor Weybright. New York: Farrar & Rinehart. 1935.

WHO was Francis Scott Key? He was the author of "The Star Spangled Banner." Every school boy knows that. Yes, but who was he, where did he live, what did he do, how did he happen to write the national anthem, was that the only thing which entitles him to memory, and because of that is he "suspended there in history, lute or pen in hand, a man of one exploit whose career before and afterward is of no consequence"? These are things which every school boy—young or old—does not know but which are told interestingly by Mr. Weybright in this fascinating book.

Born in August, 1779, at his family's home not far from Frederick, Maryland, he spent his boyhood in that locality. He entered St. John's College, Annapolis, in 1793, graduating in 1796. As a student he met and talked with men of the type of Charles Carroll of Carrollton and Samuel Chase, the Signer, and members of the Annapolis bar, which at that time was one of the most brilliant legal groups in the country. After graduation, he began to study law in Annapolis in the office of Judge Jeremiah Chase and under the guidance of his brilliant and glamorous uncle, Philip Barton Key, the original proprietor of the famous estate "Woodley" in Washington, D. C. In 1799 he began to practice law in Frederick, where he continued his friendship with Roger Brooke Taney, whom he had met in Judge Chase's office. After his marriage in 1802, he moved to Georgetown, where his Uncle Philip was now located.

The beginning of the War of 1812 found Key a prosperous lawyer, a devout and prominent churchman and politically and conscientiously opposed to the war. Nevertheless, in 1813, when

British raiders threatened southern Maryland, Key joined Peter's artillery and served eleven days. The following year, when the British threat again became acute, Key rejoined Major Peter's command and participated in the battle of Bladensburg. Like the typical American who thinks the donning of a uniform invests him with the genius of a Napoleon, we read that Key spent his time at the battle of Bladensburg advising General Winder how to dispose his troops and in giving advice to other officers.

When the British retired from Washington after the American debacle at Bladensburg, they moved through Upper Marlboro where they arrested a Dr. Beane and took him a prisoner on the British fleet. Dr. Beane's friends being unable to secure his release, proceeded to Washington and persuaded Key to obtain the authority of the Government to visit the British fleet under a flag of truce and endeavor to secure the good and aged Doctor's release. The necessary authority being obtained from the President himself, Key rode to Baltimore and with a Col. John Skinner, who had been arranging exchanges of prisoners, sailed down the Chesapeake Bay to find the British fleet. Fortunately for them, the fleet was then sailing up the bay bound for the attack on Baltimore, and no difficulty was experienced in boarding the flag ship and pleading with the Admiral for Dr. Beane's release. The release was finally granted, but Key was informed that he and his party could not go ashore until after the attack on Baltimore was over. Thus, he was compelled to witness the bombardment of Fort McHenry.

After a night of anxiety when only "the rockets red glare, the bombs bursting in air, gave proof through the night that our flag was still there," the dawn's early light showed Key and his patriotic companions that, over the squat structures of Fort McHenry, there was still waving the largest battle flag ever flown. And incidentally, this flag is still preserved in the Smithsonian Institute in Washington.

Key began to write his song in "the dawn's early light" on the back of an old envelope. It was finished that night in a hotel in Baltimore.

The song was printed on handbills and distributed in Baltimore where in the celebration over the British defeat, it became very popular. By the time of the Civil War, it was the most popular national song. In 1916, President Wilson designated it as the song to be played on certain official occasions, and in 1931, it was designated by an Act of Congress as the national anthem.

The war over, Key returned to Georgetown and resumed his practice of law. Moved by his deep religious convictions, he interested himself in the conditions of slavery and was instrumental in the founding of Liberia. Politically, he became a Democrat and warm friend and ardent supporter of President Jackson. Through his intimacies with President Jackson he was responsible for Roger Brooke Taney's entrance into national public life, which led ultimately to Taney's appointment as Chief Justice of the Supreme Court.

R. M.

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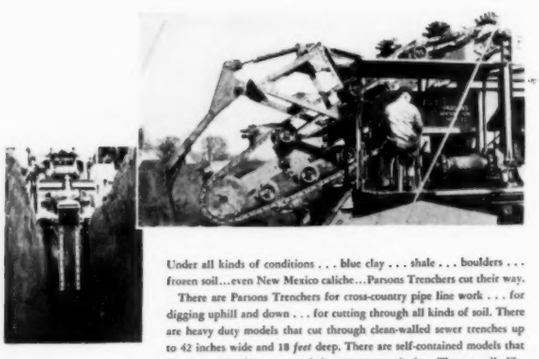

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